USER'S GUIDE

T-BERD 211

T-CARRIER ANALYZER

Telecommunications Techniques Corporation

A DYNATECH COMPANY

. . . EXPECT EXCELLENCE

MP MASTER

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Rev. J

T-BERD 211
T-CARRIER ANALYZER

USER'S GUIDE

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INTRODUCTION

The *T-BERD 211 User's Guide* offers an easy, direct method to setup and operate the T-BERD 211 within your network. The user's guide presents the most often used test setups in complete and concise steps. Illustrations, helpful notes, and step-by-step procedures make this user's guide a unique aid for novice and experienced users alike.

If you are unfamiliar with the instrument, please refer to the *T-BERD 211 Reference Manual* for more detailed information. If you should require additional help, call TTC Customer Service at (800) 638-2049.

The user's guide is divided into the following four sections:

BASIC SETUPS — Describes setup procedures to generate printouts, perform timed tests, and setup the T-BERD 211 with the T-BERD Repeater Extender for mid-span tests.

APPLICATIONS — Describes setup procedures and results interpretation for several T-BERD 211 applications. Each application identifies the test scenario, the purpose of the test, and required options. The tests are grouped as follows:

- Testing T1 Networks
- TDR Testing
- Testing Newly Installed T1 Spans
- Testing Digital Loop Carrier (DLC) Networks

AUXILIARY FUNCTIONS — Lists the T-BERD 211 and T-BERD DLC Analyzer Option auxiliary functions.

SIGNAL ALARMS AND TEST RESULTS — Lists the T-BERD 211 and T-BERD DLC Analyzer Option signal alarm definitions and test results by category.

This user's guide contains applications for the following T-BERD 211 options. The options used are identified at the beginning of the application. One or more of the options may be used in a single application.

Option 211-1	G.821 Performance Analysis Option
Option 211-2	Jitter Spectral Analysis Option
Option 211-3	Advanced BERT Option
Option 211-4	Enhanced ESF Option
Option 211-5	Time Domain Reflectometer Option
Option 211-6	Fractional T1 Option
Option 211-96	T-BERD DLC Analyzer Option
Model 40849	T-BERD T1 Channel Monitor Accessory
Model 41084	T-BERD Repeater Power Supply Accessory

1. GENERATING PRINTOUTS
TTC PR-40A THERMAL PRINTER OR EQUIVALENT REQUIRED

The following information may be used to configure the T-BERD 211 and a compatible printer, such as the TTC PR-40A Thermal Printer, to generate results and controls printouts. The printer connection is found on the side panel.

If a printer is not available, you can still generate printouts by storing them in the internal print buffer.

1. **MODE switch**
   Select the AUX mode.

2. **PATTERN switch**
   Set the following auxiliary functions:

Auxiliary Function	Selections	Comments
AUX BAUD	300, 1200, 2400,	Sets the RS-232 interface baud or 4800 rate. Recommend 2400 baud for PR-40A.
AUX PARITY	NONE, ODD, or EVEN	Sets the RS-232 interface parity. Set parity to NONE when printing pulse shape, TDR, and jitter spectral analysis graphs. Recommend NONE for PR-40A.
AUX PRNT	SHORT FORMAT, NORMAL FORMAT, SUMMARY PRINT	Determines what results FMT format is printed. Recommend NORMAL FORMAT.
AUX TERM	CR or CRLF	Sets printout line terminator. Set the terminator to CR when print ing pulse shape, TDR, and jitter spectral analysis graphs. Recommend CR for PR-40A.

3. **MODE switch**
   Exit the auxiliary functions.

4. **Connect a printer to the T-BERD 211**
   Connect an RS-232 serial cable between the printer and T-BERD 211.

5. **PRINT switch**
   Press the CONTROLS side of the switch to generate a controls printout to verify the proper operation of the printer and T-BERD 211.

6. **PRINT EVENT switch**
   Select the necessary print event function to generate the appropriate results printout. Printouts for pulse shape, TDR, and jitter spectral analysis graphs are described in the appropriate application.

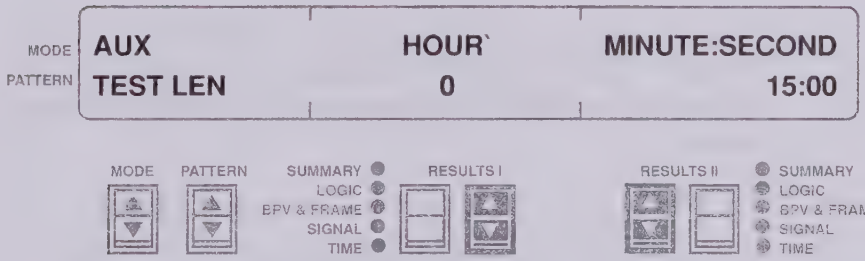
2. CONFIGURING FOR A TIMED TEST

The following procedure enables the user to run an unattended test for an extended period and collect test results during and after the test. Perform the following procedure to set up the T-BERD 211 for a timed test and print the results at the end of the test. Specific results printouts are generated during the test by selecting the desired print event function with the **PRINT EVENT** switch.

1. **Connect compatible printer (optional)**
   Refer to *Application 1, Generating Printouts*, to connect a printer.

2. **MODE switch**
   Select the AUX mode.

3. **PATTERN switch**
   Select AUX TEST LEN to set the desired duration.



4. **MODE switch**
   Exit the auxiliary functions.

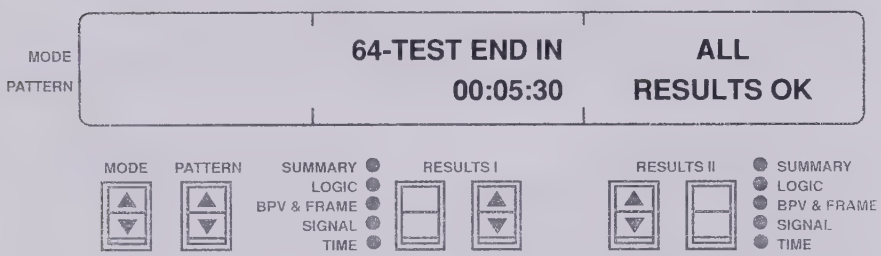
5. **PRINT EVENT switch (optional)**
   Select the TEST END print event function to generate the test end results printout at the end of the test when the **TEST** switch is set to TIMED. The test end results printout can also be printed from the other print event functions simply by setting the **TEST** switch to TIMED.

6. **TEST switch**

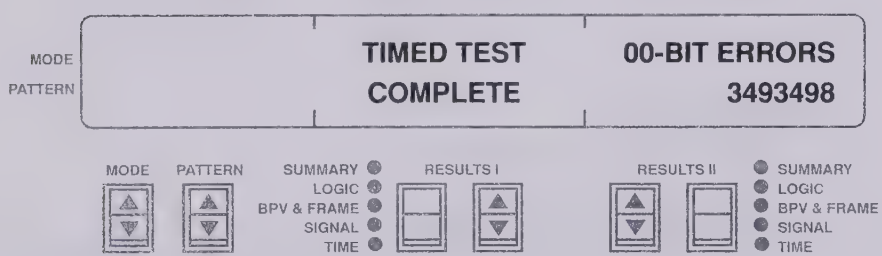
   Select TIMED test. Selecting the TIMED test restart the test.

7. **RESULTS switches**

   Select the TIME category 64-TEST END IN result in the RESULTS I window and the SUMMARY category in the RESULTS II window.



When the 64-TEST END IN result equals 00:00:00, the test is complete. *TIMED TEST COMPLETE* flashes alternately with the test result in the RESULTS I window, and the test result counts are frozen.



3. CONNECTING THE T-BERD 211 AT MID-SPAN
T-BERD T1 REPEATER EXTENDER REQUIRED

The following procedure enables the user to connect the T-BERD 211 to a T1 circuit at a span repeater location. Refer to the *T-BERD T1 Repeater Extender Model 41157 Operating Manual* for more detailed configurations. Figure 1 illustrates how the T-BERD 211 and the T-BERD Repeater Extender are connected to the T1 span.

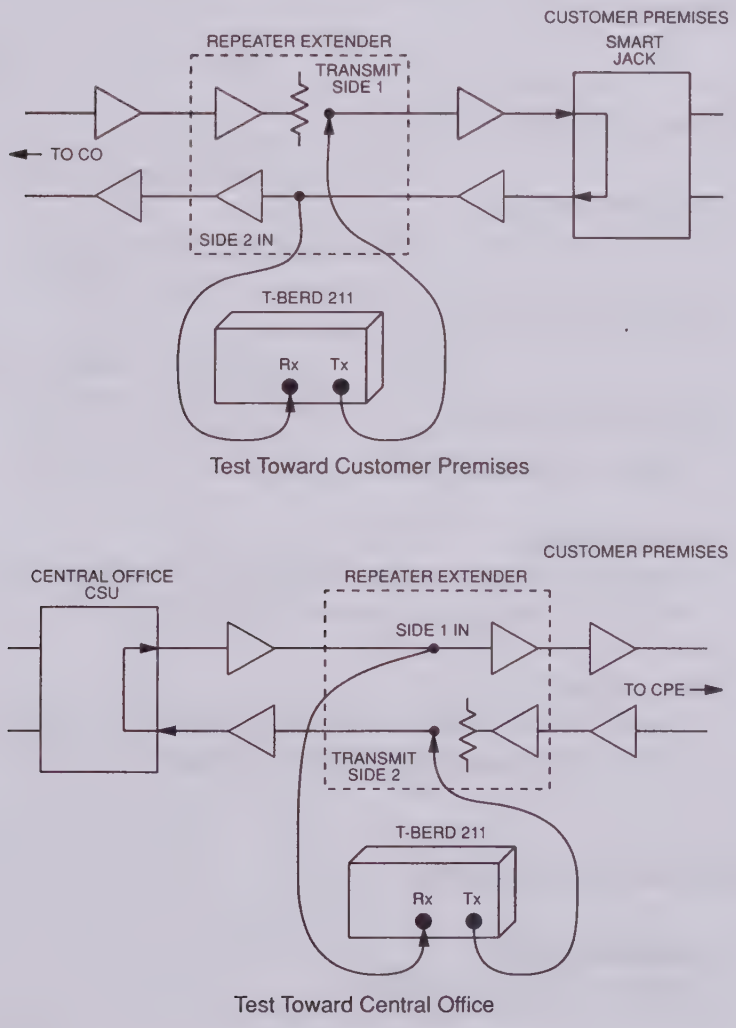


Figure 1
Testing from Mid-Span

T-BERD Repeater Extender Test Setup

1. **Remove repeater**
   Remove the desired repeater from the repeater housing unit and insert the repeater into the T-BERD Repeater Extender.

2. **Insert T-BERD Repeater Extender**
   Insert the T-BERD Repeater Extender into the desired repeater slot.

Test Toward Customer Premises

1. **TRANSMIT switch**
   Set this switch to TX SIDE 1.

2. **SIGNAL PATH switch**
   Set this switch to THRU.

3. **CURRENT PATH switch**
   Set this switch to THRU.

4. **TRANSMIT jack**
   Connect a cable between the T-BERD 211 TRANSMIT jack and the T-BERD Repeater Extender TRANSMIT jack.

5. **SIDE 2 IN jack**
   Connect a cable between the T-BERD 211 RECEIVE jack and the T-BERD Repeater Extender SIDE 2 IN jack.

Test Toward Central Office

1. **TRANSMIT switch**
   Set this switch to TX SIDE 2.

2. **SIGNAL PATH switch**
   Set this switch to THRU.

3. **CURRENT PATH switch**
   Set this switch to THRU.

4. **TRANSMIT jack**
   Connect a cable between the T-BERD 211 TRANSMIT jack and the T-BERD Repeater Extender TRANSMIT jack.

5. **SIDE 1 IN jack**
   Connect a cable between the T-BERD 211 RECEIVE jack and the T-BERD Repeater Extender SIDE 1 IN jack.

T-BERD 211 Test Setup

1. **RECEIVE INPUT switch**
   Select the BRIDGE input level.

2. **TRANSMIT OUTPUT switch**
   Select the 0dB(DSX) output level.

3. **Configure T-BERD 211**
   Configure the T-BERD 211 as described in one of the following loopback applications.

APPLICATIONS

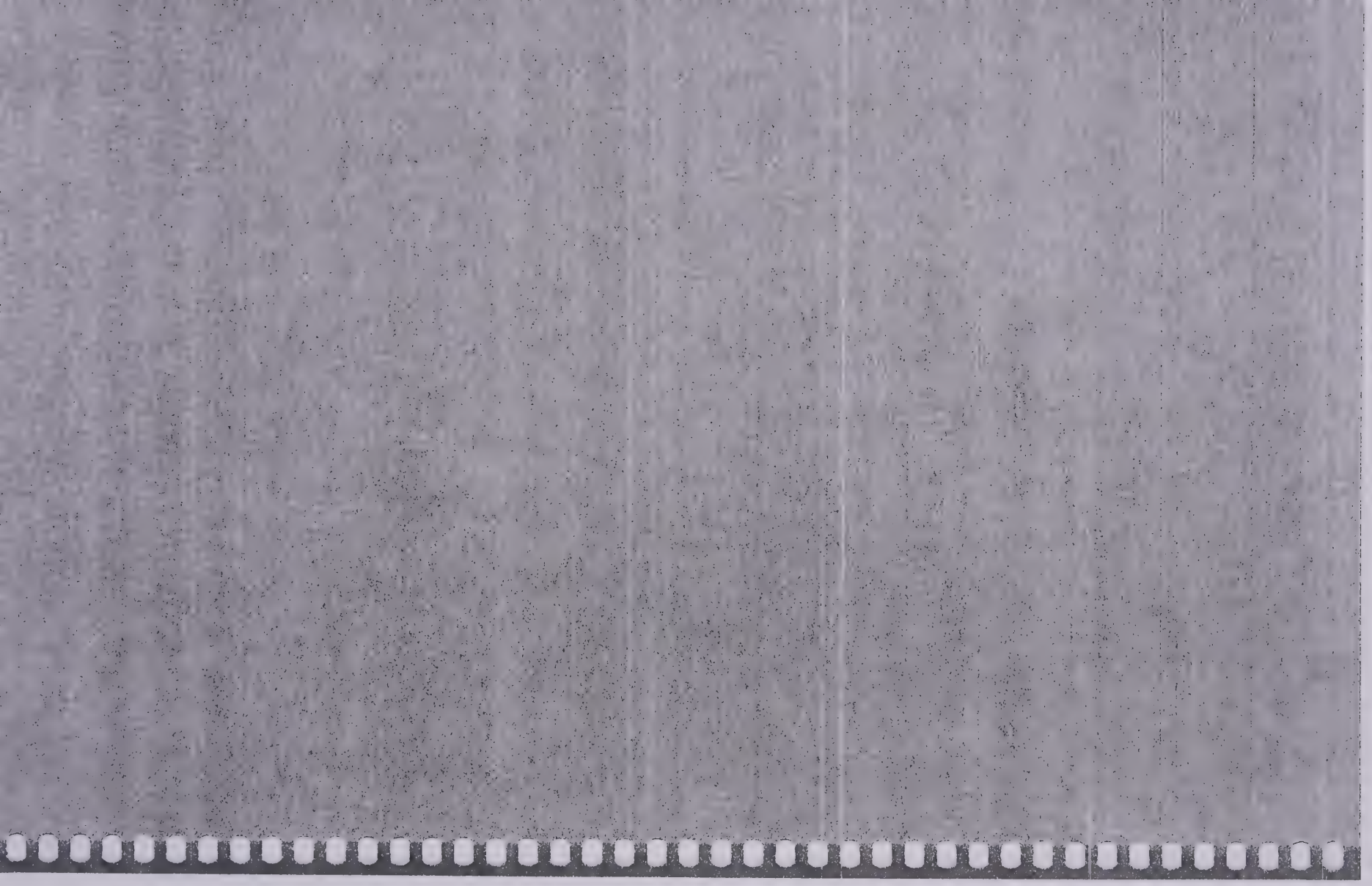
This section provides information on operating the T-BERD 211 in a variety of common test applications. Each application describes how to configure the T-BERD 211 mainframe, connect to the circuit being tested, and interpret the test results. If an option is required, the mainframe and option setup procedures are subdivided, and the option is indicated in the title of the application. The test scenarios and instrument setups are grouped into the following applications:

Testing T1 Networks

Testing Cable Pairs

Testing Newly Installed T1 Spans

Testing Digital Loop Carrier (DLC) Networks



4. MONITORING T1 PERFORMANCE

- Non-intrusively monitor the T1 facility.
- Monitor the T1 signal for BPVs, frame errors, and CRC errors (ESF framing only).
- Measure the T1 signal level and frequency.

Figure 2 illustrates the T-BERD 211 monitoring the T1 signal from the DSX-1 access point.

1. **MODE switch**
   Select AUTO mode.

2. **TEST switch**
   Set to CONT.

3. **TIMING switch**
   Set to RECOVD (LOOP).

4. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

5. **RESTART switch**
   Clear the results and start the test.

6. **MODE/PATTERN window**
   Verify received framing format and pattern. The framing format and pattern (or *live*) appear in lowercase characters.

7. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

8. **RESULTS I switches**
   Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.

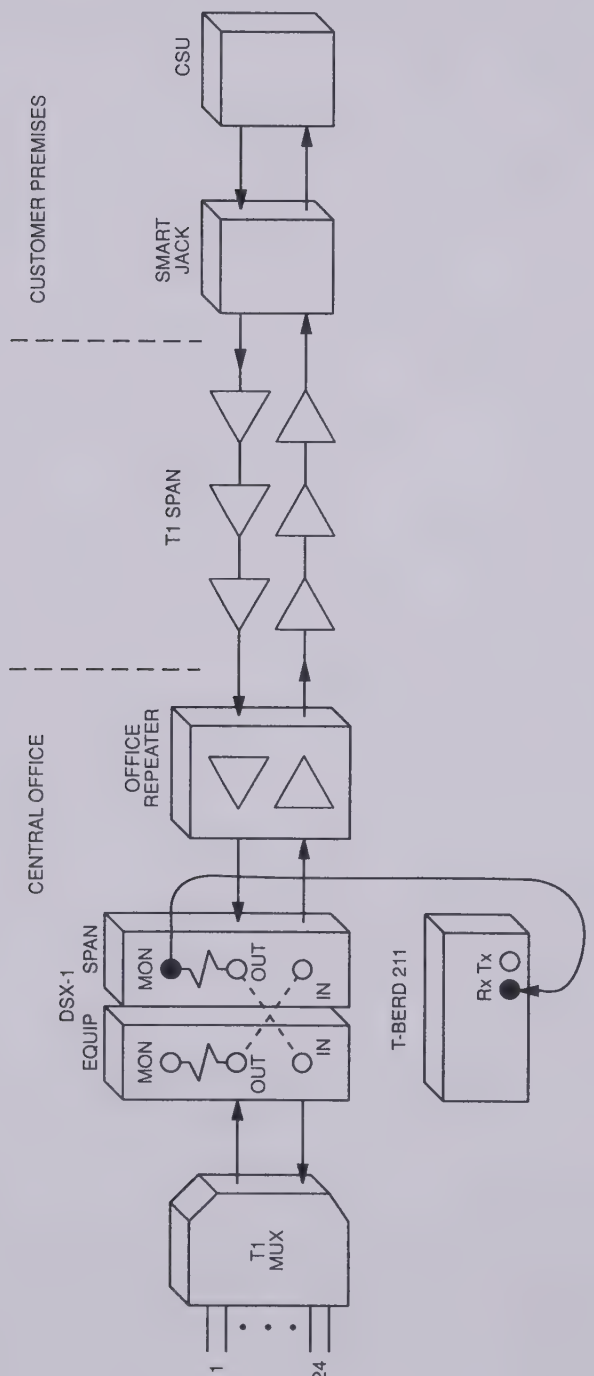
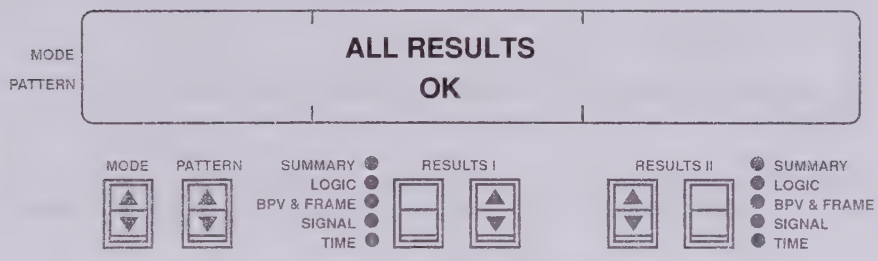


Figure 2
Monitoring T1 Performance



9. Results interpretation

25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or network synchronization.

41-RX LEVEL (dBdsx)

The received level should be -20 dBdsx ±1.5 dBdsx at resistor isolated DSX-1 MON jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end.

5. MEASURING T1 TIMING SLIPS AND WANDER

- Confirm that all the network equipment is properly synchronized.
- Verify network timing and wander.
- Isolate possible timing problems and wander.

Figure 3 illustrates the T-BERD 211 testing for the presence of timing slips when the received T1 signal is compared with a reference T1 clock source at the DSX-1 access point.

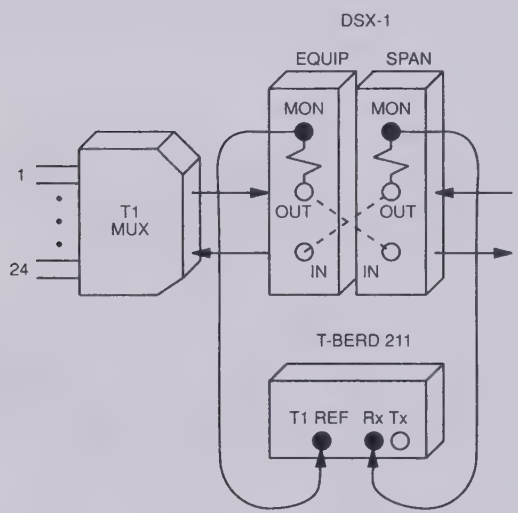


Figure 3
Measuring T1 Timing Slips

1. **MODE switch**
   Select AUTO mode.

2. **TEST switch**
   Set to CONT.

3. **TIMING switch**
   Set to RECOVD (LOOP).

4. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

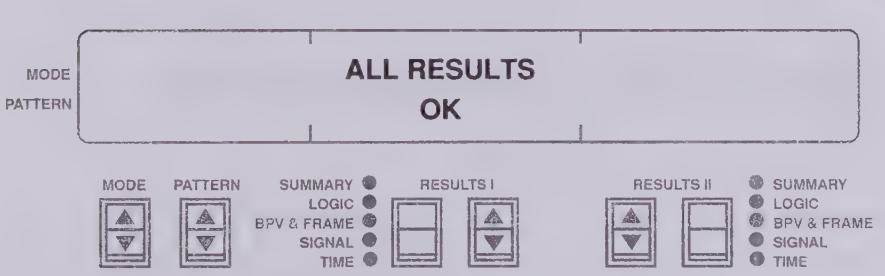
5. **T1 REF (TDR) jack**
   Connect a cable between this jack and the equipment-side DSX-1 MON jack.

6. **RESTART switch**
   Clear the results and start the test.

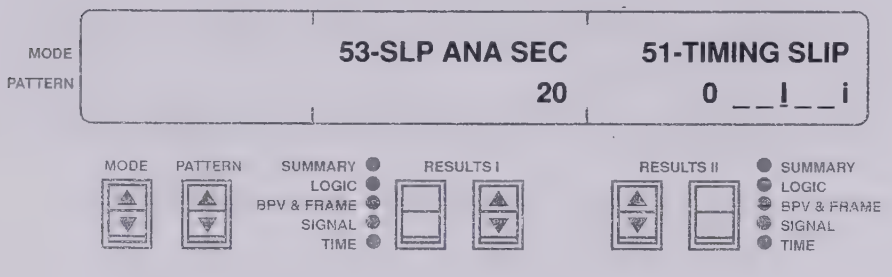
7. **MODE/PATTERN window**
   Verify received framing format and pattern. The framing format and pattern (or *live*) appear in lowercase characters.

8. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

9. **RESULTS I switches**
   Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



10. **RESULTS switches**
    Select the SIGNAL category 53-SLP ANA SEC and 51-TIMING SLIP results.



11. Results interpretation

51-TIMING SLIP

The 51-TIMING SLIP result is only available when the timing reference source is connected to either the T1 REF (TDR) jack or the EXT CLK IN connector. Figure 4 shows the bar graph and wheel values that determine the direction and number of timing slips being detected.

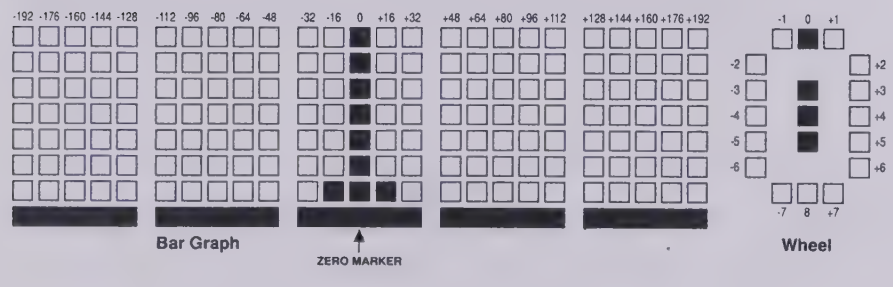


Figure 4
Timing Slip Bar Graph and Wheel Values

If the T1 reference and receive signals are perfectly synchronized, the timing slip count remains at 0, the bar graph remains centered, and the wheel remains at top center.

If the T1 reference and received signals are synchronized, but one signal exhibits low-speed wander (e.g., Doppler shifts from satellites), the timing slip count remains at 0, the wheel moves clockwise, and the bar graph moves to the right as the satellite nears. As the satellite moves farther away, the timing slip count remains at 0, the wheel moves counterclockwise, and the bar graph moves to the left.

If the T1 reference and received signals are not synchronized, and the received signal frequency is higher than the T1 reference signal, the wheel moves clockwise, the bar graph moves to the right, and the timing slip count increments every 193 bit slips. The timing slip count, bar graph, and wheel move very rapidly when the frequency differs more than a few Hertz.

If the T1 reference and received signals are not synchronized, and the received signal frequency is lower than the T1 reference signal, the wheel moves counterclockwise, the bar graph moves to the left, and the timing slip count increments every 193 bit slips. The timing slip count, bar graph, and wheel move very rapidly when the frequency differs more than a few Hertz.

53-SLP ANA SEC

The 53-SLP ANA SEC result increments when both the T1 reference signal and the received T1 signal are present and timing slips are occurring.

70-WANDER +PK, 71-WANDER -PK, and 72-P-P WANDER

Positive-peak, negative-peak, and peak-to-peak wander results indicate maximum wander conditions since the beginning of the test. Wander can be monitored to determine whether it exceeds tolerances for the terminal buffers. Wander is measured in Unit Intervals (UIs); 1 UI is equivalent to a single T1 timeslot or one bit space in a buffer. Wander is a form of jitter that occurs at frequencies of less than 10 Hz.

73-15m WANDER and 74-24h WANDER

The 15-minute and 24-hour wander results indicate the maximum peak-to-peak wander over the last indicated period. The 15-minute result is not available for the first 15 minutes of the test and is updated once per minute. The 24-hour result is not available for the first 24 hours of the test and is updated once per hour.

75-TIE WANDER

The Time Interval Error wander result is a measurement of the instantaneous displacement of the received T1 signal from the reference signal since the beginning of the test. This result can be positive or negative.

6. MEASURING T1 PULSE SHAPES

- Measure waveform against standard pulse shape masks (ANSI T1.403, AT&T CB119).

Figure 5 illustrates the T-BERD 211 connected to the span through the DSX-1 patch panel to loop the far-end equipment and test the signal pulse shape.

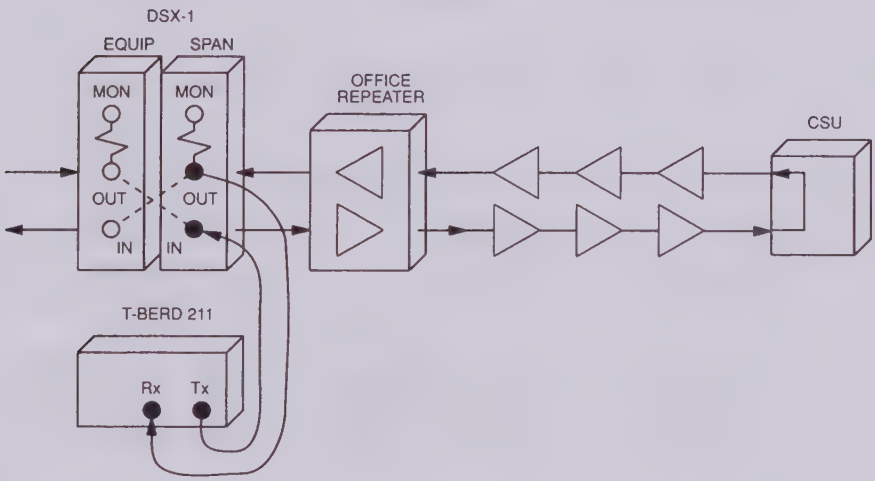
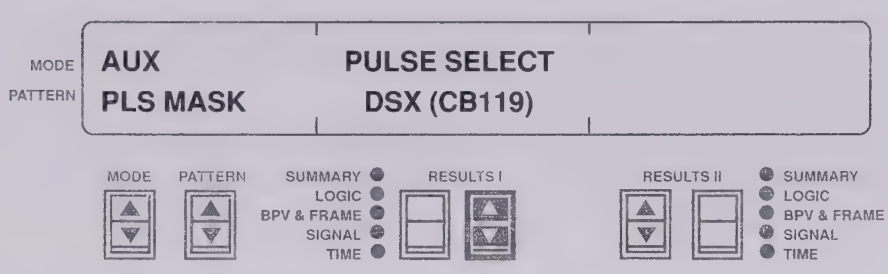


Figure 5
Measuring the DS1 Pulse Shapes

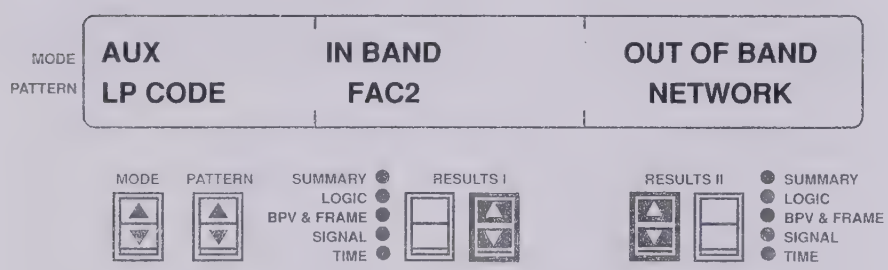
1. **Connect compatible printer (optional)**
   Refer to *Application 1, Generating Printouts*, to connect a printer to the T-BERD 211.

2. **MODE switch**
   Select the AUX mode.

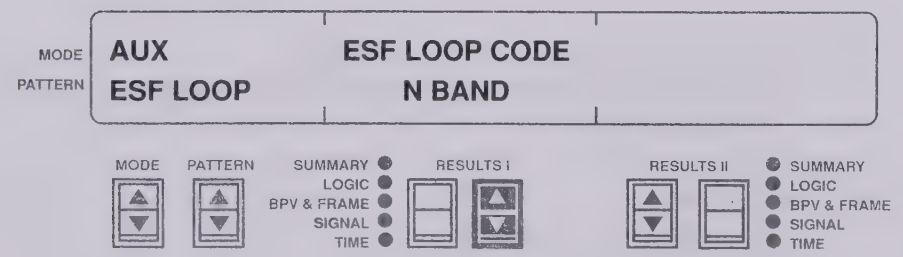
3. **PATTERN switch**
   Select AUX PLS MASK to set the pulse mask. Select NI (ANSI) when testing from the network interface, and DSX (CB119) when testing from the DSX-1 access point.



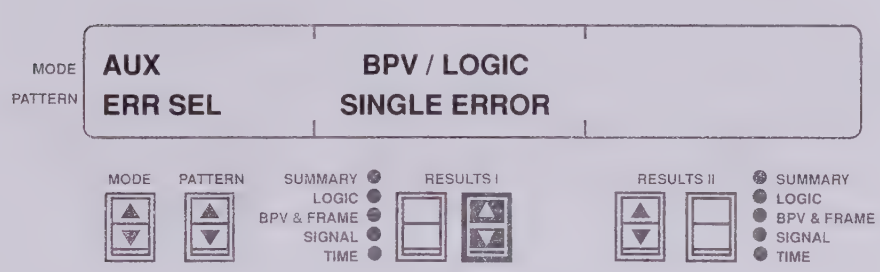
Select AUX LP CODE to set the appropriate loop code.



If testing T1 ESF circuits, select AUX ESF LOOP to set the loop code type.



Select AUX ERR SEL to set the burst duration to insert a single error.



4. **MODE switch**
   Exit the auxiliary function and select the appropriate T1 network framing format.

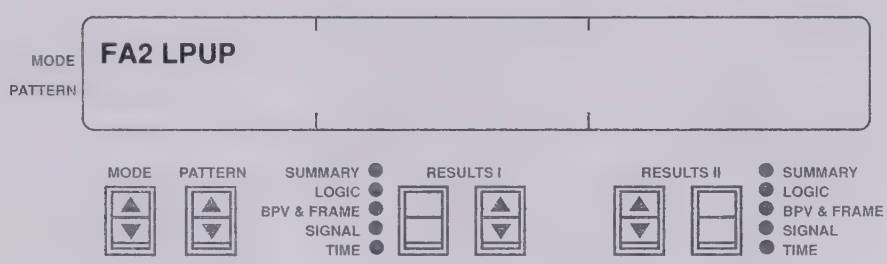
5. **PATTERN switch**
   Select the 1:7 test pattern.

6. **TIMING switch**
   Set to INT.

7. **RECEIVE INPUT switch and jack**
   Select the TERM input level and connect a cable between this jack and the span-side DSX-1 OUT jack.

8. **TRANSMIT OUTPUT switch and jack**
   Select the 0dB(DSX) output level and connect a cable between this jack and the span-side DSX-1 IN jack.

9. **LOOP UP switch**
   Press this switch to send the loop-up code. The switch and Loop Up LED illuminate until the loop code is detected. A loop-up code message appears in the display. The test restarts when the loopback is established.



10. **Status LEDs**

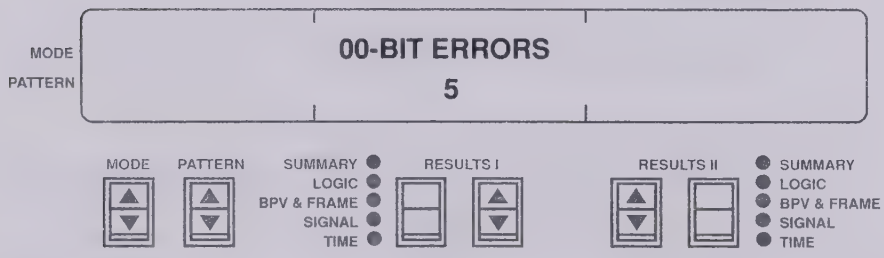
When the loopback is established, these LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

11. **RESULTS I Category switch**

Select the SUMMARY category.

12. **LOGIC ERROR INSERT switch**

Press this switch five times to verify that the logic errors are received and the T1 circuit is looped back.



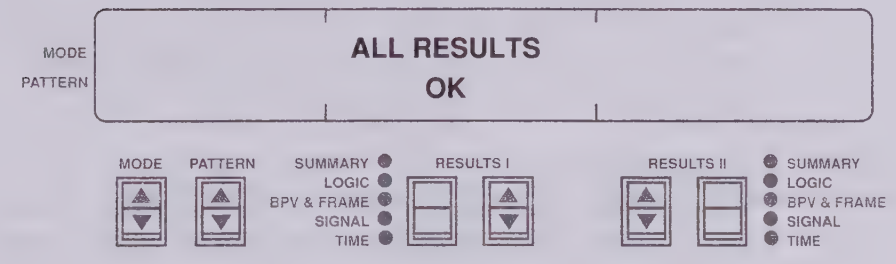
If the loopback is not established, the bit errors do not appear in the display. The failed loopback could be caused by the NIU/CSU not operating correctly, the line from you to the NIU/CSU is bad, or the transmitted loop code is incorrect.

13. **RESTART switch**

Clear the results and start the test.

14. **RESULTS I switches**

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



15. **Results interpretation**

41-RX LEVEL (dBdsx)

The received level should be +4 to -4 dBdsx at terminated DSX-1 OUT jacks to measure the pulse shape. Levels outside this range cause the message *OUT OF RANGE* to appear in the pulse shape results.

44-PULSE SHAPE

This indicates a pass/fail response to whether the measured pulse shape falls within the selected pulse mask.

45-PULSE WIDTH

This indicates the pulse width at the 50% point of the waveform. The DSX (CB119) specification requires a pulse width of 350 ns ±56 ns. The NI (ANSI) specification requires a pulse width of 356 ns ±56 ns.

46-RISE TIME

This indicates the rise time of the leading edge between the 10% and 90% points of the waveform. The DSX (CB119) specification requires a rise time of less than 140 ns. The NI (ANSI) specification requires a rise time of less than 152 ns.

47-FALL TIME

This indicates the fall time of the trailing edge between the 10% and 90% points of the waveform. The DSX (CB119) specification requires a fall time of less than 117 ns. The NI (ANSI) specification requires a fall time of less than 125 ns.

48-UNDERSHOOT

The undershoot is the amount of the trailing edge that falls below the zero point of the waveform. The DSX (CB119) and NI (ANSI) specifications require an undershoot of less than 45% of the normalized pulse.

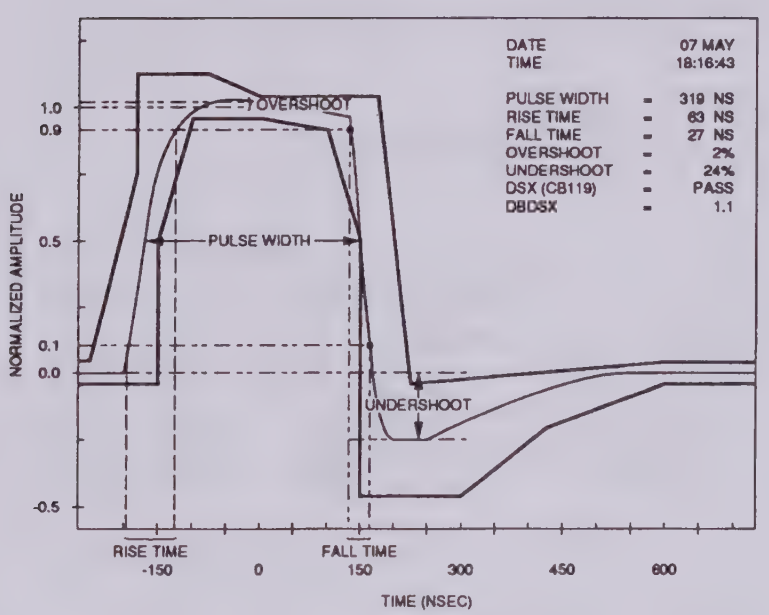
49-OVERSHOOT

The overshoot is the amount of the leading edge that rises above the 100% point of the waveform. The DSX (CB119) specification requires an overshoot of less than 15% of the normalized pulse. The NI (ANSI) specification requires an overshoot of less than 20% of the normalized pulse.

Pulse Shape LED

When either pulse mask is selected, the LED illuminates when the pulse shape exceeds the pulse mask specifications. When NONE is selected, the Pulse Shape LED is disabled, the message *NO MASK* appears in the 44-PULSE SHAPE result, and no mask appears on the pulse shape printout.

A pulse mask is a graphical representation of the guidelines or template that is placed on the pulse shape. Figure 6 depicts a sample pulse mask, pulse waveform, and the expected pulse shape parameters by the indicated pulse mask. The pulse width, rise time, fall time, undershoot, and overshoot are indicated in Figure 6 as well as results in the SIGNAL category.



EXPECTED PULSE SHAPE PARAMETERS

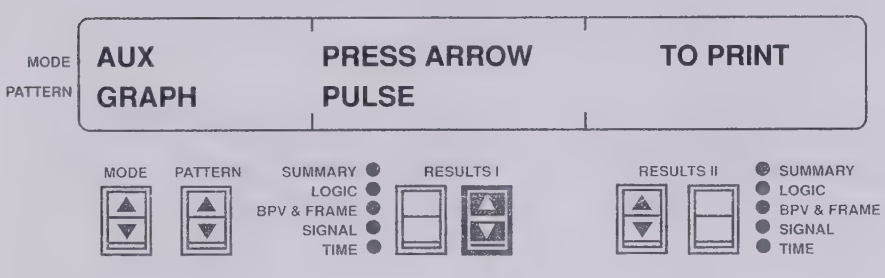
PARAMETER	MASK	
	DSX	NETWORK INTERFACE
Pulse Width	350 ± 56 ns	350 ± 56 ns
Rise Time	< 140 ns	< 152 ns
Fall Time	< 117 ns	< 125 ns
% Overshoot	< 15%	< 20%
%Undershoot	< 45%	< 45%

Figure 6
T1 Pulse Shape and Pulse Mask Specifications

Print Pulse Shape Graphs

16. **MODE switch**
    Select the AUX mode.

17. **PATTERN switch**
    Select the AUX GRAPH function.



18. **RESULTS I Results switch**
    Press this switch to generate a pulse shape graph (see Figure 7).

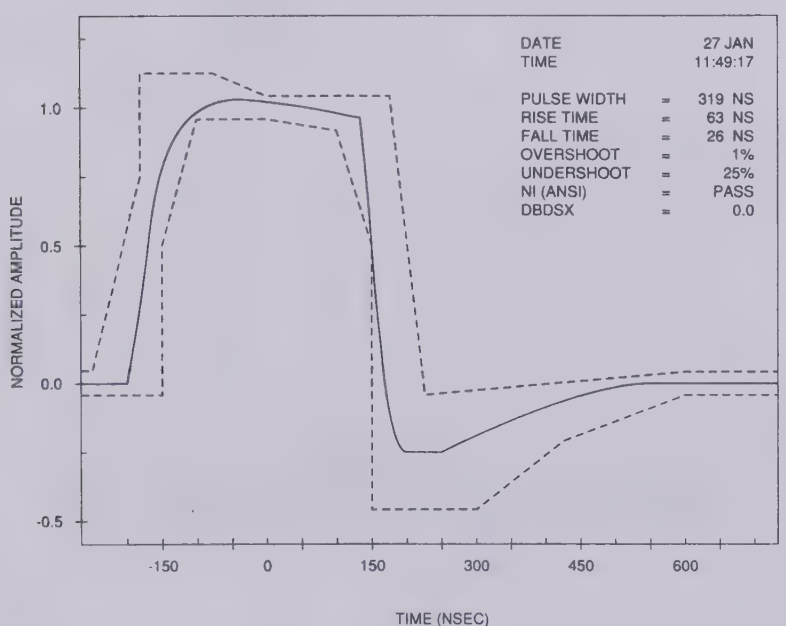
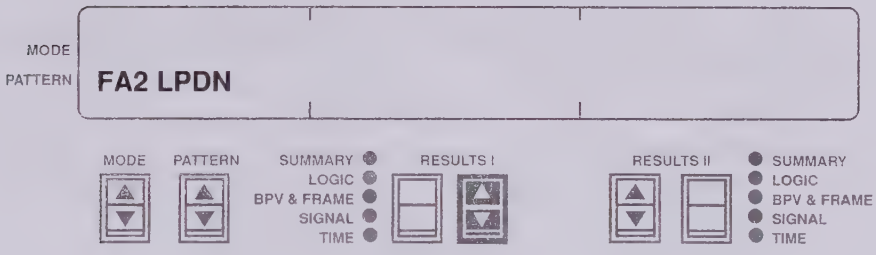


Figure 7
T1 Pulse Shape Graph

Disconnect the T-BERD 211

19. **LOOP DOWN switch**

Press this switch to send the loop-down code. The switch and Loop Down LED illuminate until the loopback is released. A loop-down code message appears in the display. Disconnect the T-BERD 211 from the span.



7. MEASURING T1 JITTER

- Non-intrusively monitor the T1 facility for jitter.
- Measure the T1 signal for the current and maximum peak-to-peak wideband and highband jitter.

Figure 8 illustrates the T-BERD 211 monitoring the T1 signal for jitter from the DSX-1 access point.

1. **MODE switch**
   Select AUTO mode.

2. **TIMING switch**
   Set to RECOVD (LOOP).

3. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

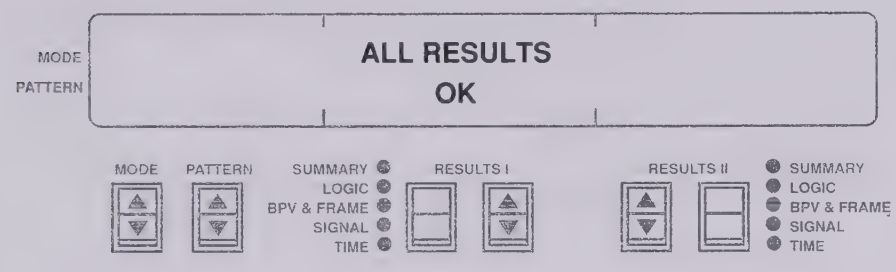
4. **RESTART switch**
   Clear the results and start the test.

5. **MODE/PATTERN window**
   Verify received framing format and pattern. The framing format and pattern (or live) appear in lowercase characters.

6. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

7. **RESULTS I switches**
   Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.

Figure 8
Measuring T1 Jitter



8. **Results interpretation**

25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

Excessive jitter causes BPVs, frame errors, and CRC errors.

41-RX LEVEL (dBdsx)

The received level should be -16 dBdsx to -24 dBdsx at resistor isolated DSX-1 MON jacks to measure the T1 jitter. Levels outside this range cause the message *OUT OF RANGE* to appear in the jitter results.

80-WB/HB JIT

Check this result to determine if the wideband and highband jitter and the signal level are within specifications.

PASS appears when the wideband jitter is less than 5.0 UI and highband jitter is less than 0.1 UI. The signal level is within prescribed limits.

FAILED appears when the wideband jitter is greater than 5.0 UI and highband jitter is greater than 0.1 UI. The signal level is within prescribed limits.

OUT OF RANGE appears when the signal level is outside prescribed limits.

81-WB JITTER and 82-HB JITTER

If the 81-WB JITTER result exceeds 5.0 UI, then a multiplexer may be causing the excess wideband jitter. Multiplexers often cause waiting time jitter, which appears as low frequency jitter.

If the 82-HB JITTER exceeds 0.1 UI, and the 81-WB JITTER result reads the same value, then a span line problem such as a bad repeater may be causing the jitter.

84-MAX WB JIT and 85-MAX HB JIT

If the history Jitter LED illuminates, but the current Jitter LED is off, the maximum peak-to-peak wideband and highband jitter can be read from these results.

Jitter LED

This LED illuminates when wideband jitter exceeds 5.0 UI or highband jitter exceeds 0.1 UI.

8. PERFORMING T1 JITTER SPECTRAL ANALYSIS *JITTER SPECTRAL ANALYSIS OPTION REQUIRED*

- Measure the spectral jitter response against a selected jitter mask specification.

Figure 9 illustrates the T-BERD 211 connected to the span through the DSX-1 patch panel to loop the far-end equipment and test the full T1 bandwidth for jitter.

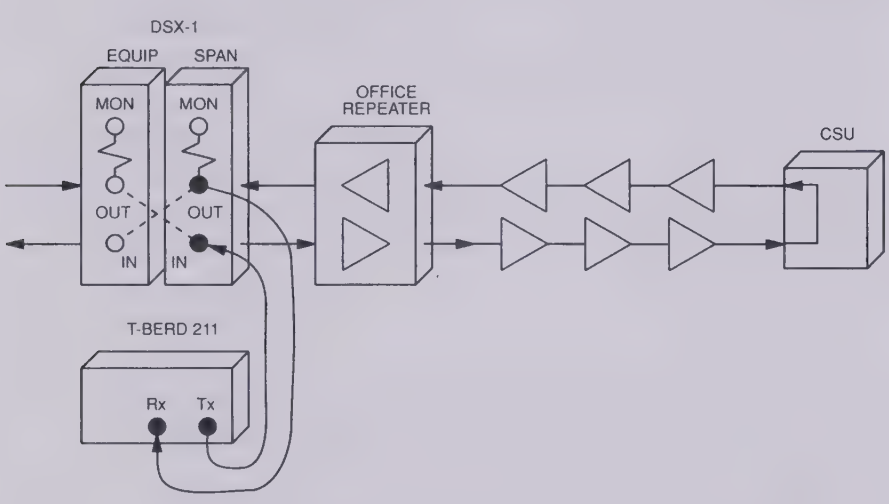


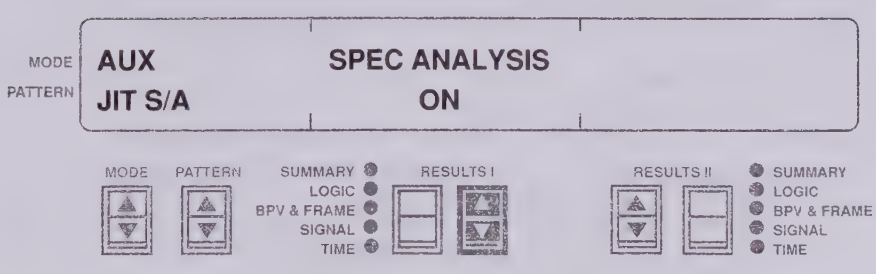
Figure 9
T1 Jitter Spectral Analysis During Loopback Testing

1. **Connect compatible printer (optional)**
   Refer to *Application 1, Generating Printouts*, to connect a printer to the T-BERD 211.

2. **MODE switch**
   Select the AUX mode.

3. **PATTERN switch**

Select AUX JIT S/A to enable the Jitter Spectral Analysis Option.



Select AUX JIT MASK to set the appropriate jitter mask.

Select AUX JIT TRIG to set the appropriate jitter trigger.

4. **MODE switch**
   Select AUTO mode.

5. **TIMING switch**
   Set to RECOVD (LOOP).

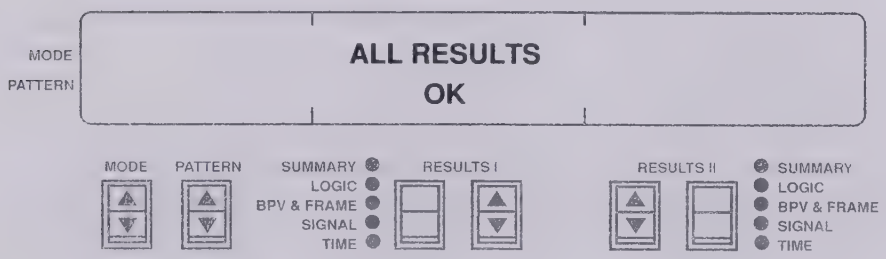
6. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

7. **RESTART switch**
   Clear the results and start the test.

8. **MODE/PATTERN window**
   Verify received framing format and pattern. The framing format and pattern (or live) appear in lowercase characters.

9. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

10. **RESULTS I switches**
    Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



11. Results interpretation

41-RX LEVEL (dBdsx)

The received level should be +4 to -4 dBdsx at the terminated DSX-1 OUT jacks to measure the jitter. Levels outside this range cause the message *OUT OF RANGE* to appear in the jitter results.

88-SA P/F

Check this result to determine if the spectral content of each frequency band is within the selected jitter mask specification. Refer to Table 1 to determine which test results appear when configuring the jitter auxiliary functions.

PASS appears when the wideband jitter is less than 5.0 UI and highband jitter is less than 0.1 UI. The signal level is within prescribed limits.

FAILED appears when the wideband jitter is greater than 5.0 UI and highband jitter is greater than 0.1 UI. The signal level is within prescribed limits.

OUT OF RANGE appears when the signal level is outside prescribed limits.

89-SA FREQ (auto scrolling) and 90-SA FREQ (manual scrolling)

If any frequency band exceeds the jitter mask when the error event occurs, then jitter is the likely cause of the errors. This conclusion can be confirmed by taking several spectral analysis samples when no errors are present, and comparing them with the error event samples.

If the Jitter LED illuminates, but none of the frequency bands indicate jitter above 100% of the selected jitter mask, with no error events, then the errors may be caused by an in-phase summing of many jitter frequencies. Again, spectral analysis samples where errors are present should be taken to correlate the high jitter and low jitter measurements.

Table 1
Spectral Analysis Results and Auxiliary Functions

Results	Displayed Information	Auxiliary Function	Selection
88-SA P/F	N/A	AUX JIT S/A	OFF
89-SA FREQ	UNAVAILABLE	AUX JIT MASK	NONE
90-SA FREQ	(not shown)		
88-SA P/F	N/A	AUX JIT S/A	ON
89-SA FREQ	Frequencies and UI	AUX JIT MASK	NONE
90-SA FREQ	Frequencies and UI		
88-SA P/F	Pass/Fail/Unavailable	AUX JIT S/A	ON
89-SA FREQ	Frequencies and % Mask	AUX JIT MASK	Mask
90-SA FREQ	Frequencies and % Mask		
88-SA P/F	UNAVAILABLE	AUX JIT S/A	OFF
89-SA FREQ	UNAVAILABLE	AUX JIT MASK	Mask
90-SA FREQ	(not shown)		

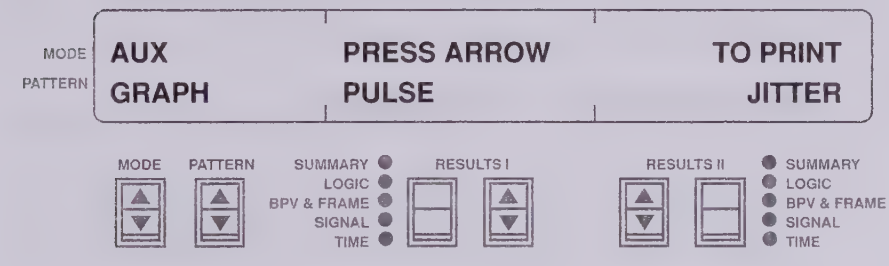
Jitter LED

When the Jitter Spectral Analysis Option is enabled and a jitter mask is selected, the LED illuminates when the jitter spectral response exceeds 100% of the selected jitter mask. When the Jitter Spectral Analysis Option is enabled but a jitter mask is not selected, the LED is disabled.

Printing Jitter Spectral Analysis Graph

12. **MODE switch**
    Select the AUX mode.

13. **PATTERN switch**
    Select the AUX GRAPH function.



14. RESULTS II Results switch

Press this switch to generate a jitter versus frequency graph (see Figure 10).

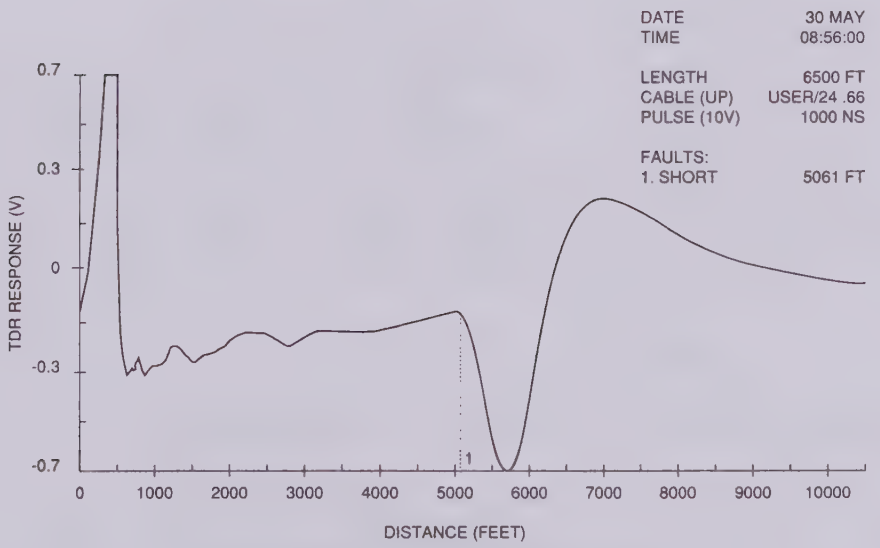


Figure 10
T1 Jitter vs. Frequency Graph

9. PERFORMING A T1 LOOPBACK

- Qualify T1 circuit error performance by testing for logic errors, BPVs, frame errors, and CRC errors (if applicable) on T1 lines.
- Check loopback response of transmission equipment.

Figure 11 illustrates the T-BERD 211 connected to the span through the DSX-1 patch panel to loop the far-end equipment and test the full T1 bandwidth.

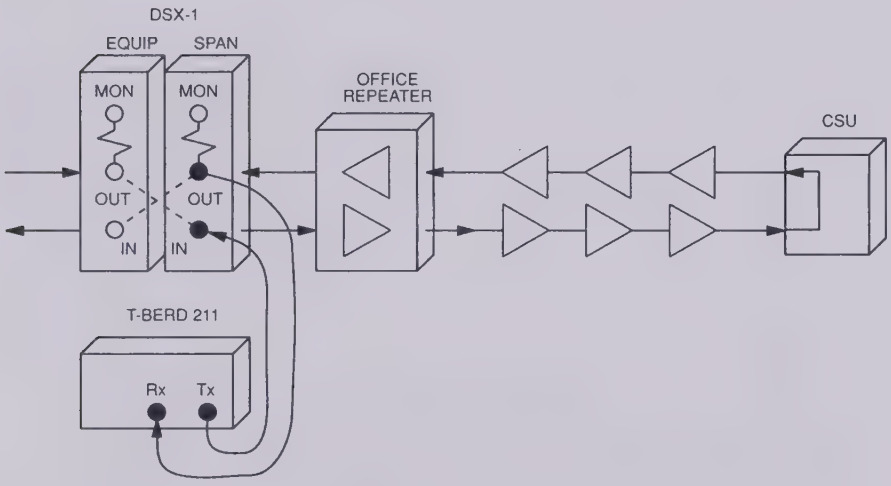
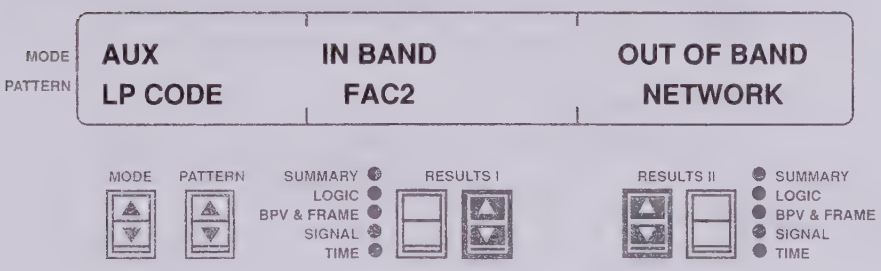


Figure 11
Performing a T1 Loopback Test

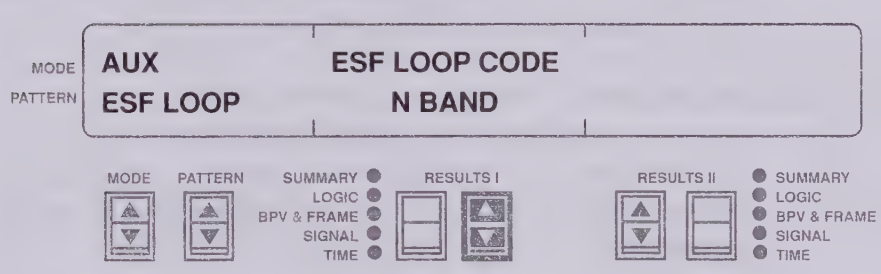
1. **MODE switch**
   Select the AUX mode.

2. **PATTERN switch**

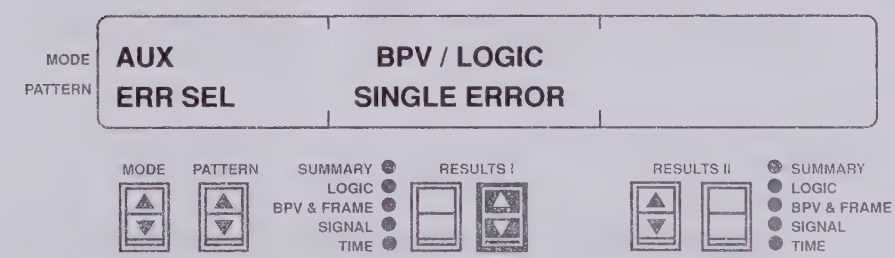
Select AUX LP CODE to set the appropriate loop code.



If testing T1 ESF circuits, select AUX ESF LOOP to set the loop code type.



Select AUX ERR SEL to set the burst duration to insert a single error.



3. **MODE switch**
   Exit the auxiliary function and select the appropriate T1 network framing format.

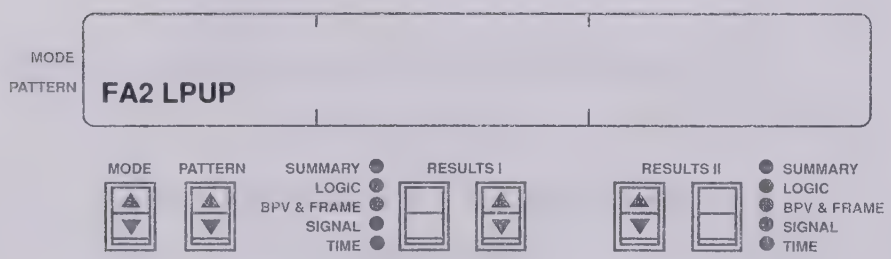
4. **PATTERN switch**
   Select the appropriate test pattern.

5. **TIMING switch**
   Set to INT.

6. **RECEIVE INPUT switch and jack**
   Select the TERM input level and connect a cable between this jack and the span-side DSX-1 OUT jack.

7. **TRANSMIT OUTPUT switch and jack**
   Select the 0dB(DSX) output level and connect a cable between this jack and the span-side DSX-1 IN jack.

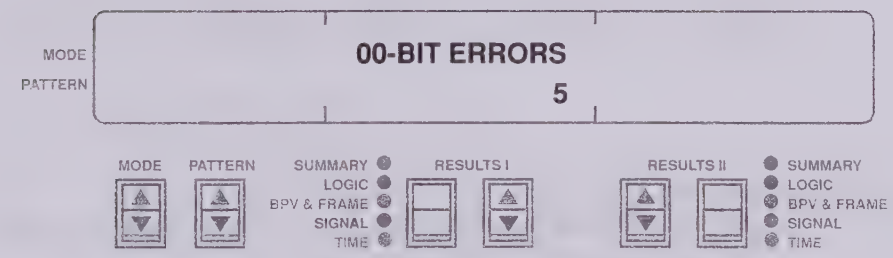
8. **LOOP UP switch**
   Press this switch to send the loop-up code. The switch and Loop Up LED illuminate until the loop code is detected. A loop-up code message appears in the display. The test restarts when the loopback is established.



9. **Status LEDs**
   When the loopback is established, these LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

10. **RESULTS I Category switch**
    Select the SUMMARY category.

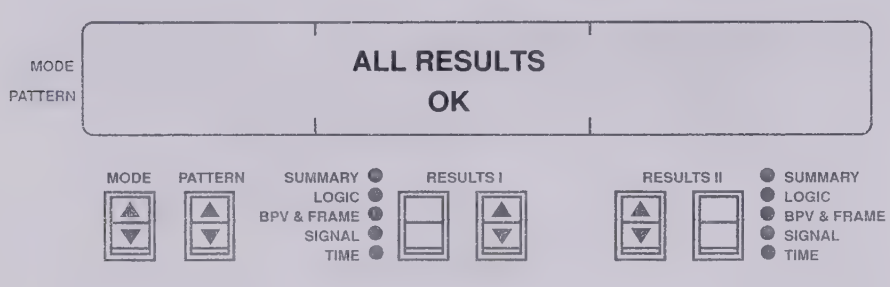
11. **LOGIC ERROR INSERT switch**
    Press the switch five times to verify that the logic errors are received and the T1 circuit is looped back.



If the loopback is not established, the bit errors do not appear in the display. The failed loopback could be caused by the NIU/CSU not operating correctly, the line from you to the NIU/CSU is bad, or the transmitted loop code is incorrect.

12. **RESTART switch**
    Clear the results and start the test.

13. **RESULTS I switches**
    Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



14. Results interpretation

00-BIT ERRORS, 25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be +4 to -4 dBdsx at the terminated DSX-1 OUT jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

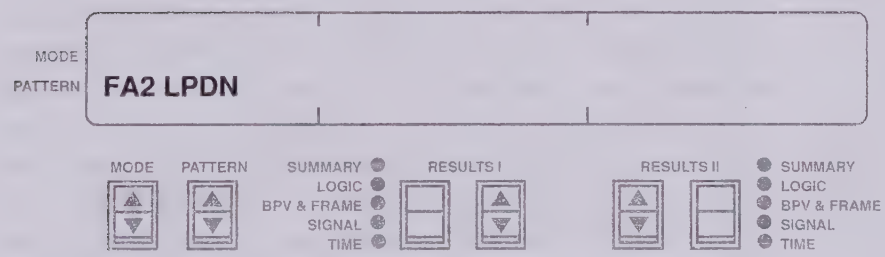
All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end. If ALL ONES, MULTIPAT, or BRIDGTAP is being used, the LED illuminates when the ALL ONES pattern is transmitted and received.

Disconnect the T-BERD 211

15. **LOOP DOWN switch**

Press this switch to send the loop-down code. The switch and Loop Down LED illuminate until the loopback is released. A loop-down code message appears in the display. Disconnect the T-BERD 211 from the span.



10. EMULATING A CSU AT CUSTOMER PREMISES

- Verify the span installation.
- Terminate the T1 line and loop simplex current.
- Measure simplex current and T1 level.
- Auto-respond to T1 loop codes.
- Functionally replace a NIU/CSU.

Figure 12 illustrates the T-BERD 211 connected to the span through the NIU and emulating a CSU at the customer premises. The central office requires a test set to be connected to the T1 span to send loop codes and test patterns.

NOTE: One of the functions of the CSU is to complete the current path for powering the regenerative repeaters on the span. HAZARDOUS VOLTAGES EXIST ON THE LINE SIDE OF THE CSU. Local telephone company office alarms may sound when the current path is interrupted. Since telephone companies do not have a uniform policy regarding the disconnection of the CSU from the span, LOCAL TELEPHONE COMPANY INTERVENTION IS STRONGLY RECOMMENDED. Advance notice should be given so that power can be removed from the span before disconnection of the CSU.

1. **MODE switch**
   Select the AUX mode.

2. **PATTERN switch**
   Select AUX RESPONSE to set the loop code response function.

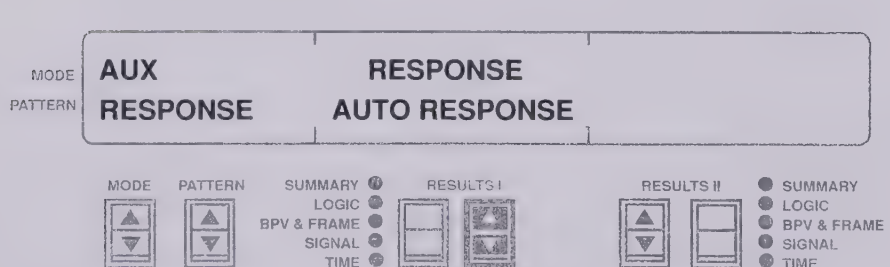
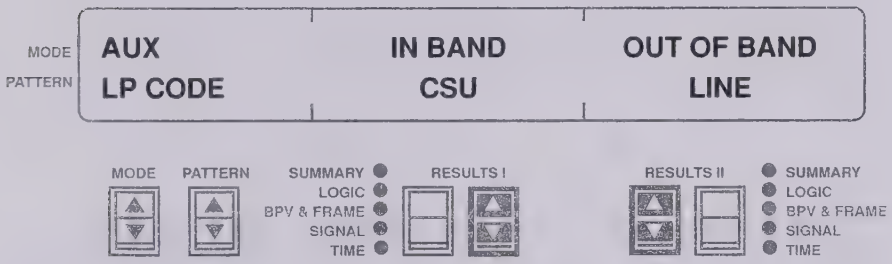
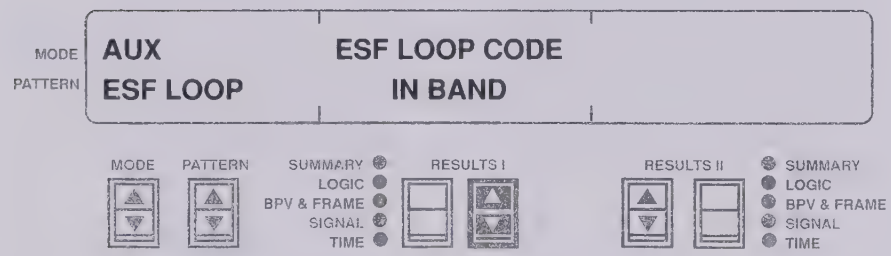


Figure 12
Emulating a CSU at the Customer Premises

Select AUX LP CODE to set the appropriate loop code.



If testing T1 ESF circuits, select AUX ESF LOOP to set the loop code type. The loop code must match the loop code being sent from the central office.



3. **MODE switch**
   Select AUTO mode.

4. **TIMING switch**
   Set to INT.

5. **Central office repeater power supply**
   Disconnect the office repeater power supply from the span being tested.

   WARNING: HIGH VOLTAGE MAY BE ENCOUNTERED.

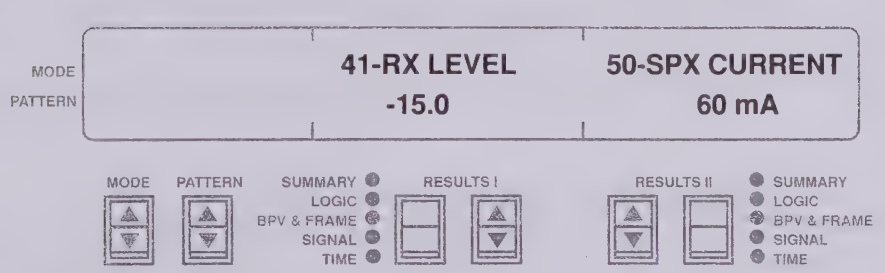
6. **RECEIVE INPUT switch**
   Select the TERM input level.

7. **Transmit and receive connections**
   Connect a cable between the T-BERD 211 and the NIU.

   WARNING: If any T-BERD 211 connector is attached to a powered span line, the line voltage is also present on the associated T-BERD 211 connections. Therefore, do not use the other connections.

8. **Central office repeater power supply**
   Connect the office repeater power supply to the span being tested.

9. **RESULTS switches**
   Select the SIGNAL category. Scroll to the 41-RX LEVEL result in one window and the 50-SPX CURRENT result in the other window.

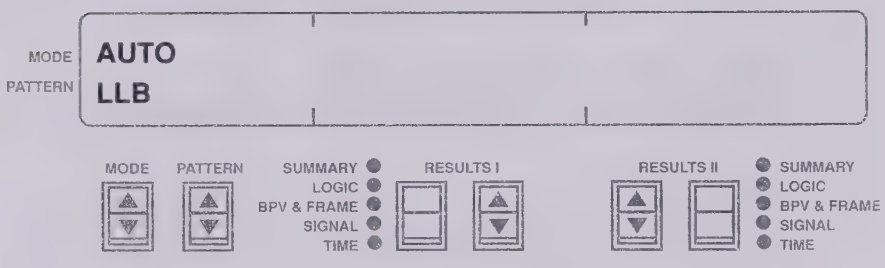


10. **TRANSMIT OUTPUT switch**
    Select the appropriate output level as follows:

    - If the receive level is -15 dBdsx and below, set the transmit level to 0 dBdsx.
    - If the receive level is -14 to -8 dBdsx and below, set the transmit level to -7.5 dBdsx.
    - If the receive level is -7.5 dBdsx and above, set the transmit level to -15 dBdsx.

11. **Send CSU loop-up code from central office to T-BERD 211**

The T-BERD 211 responds by establishing an AUTO LLB mode. This internally loops the receiver to the transmitter. The Loop Up LED illuminates when the loop-up code is received. The test restarts when the loopback is established.



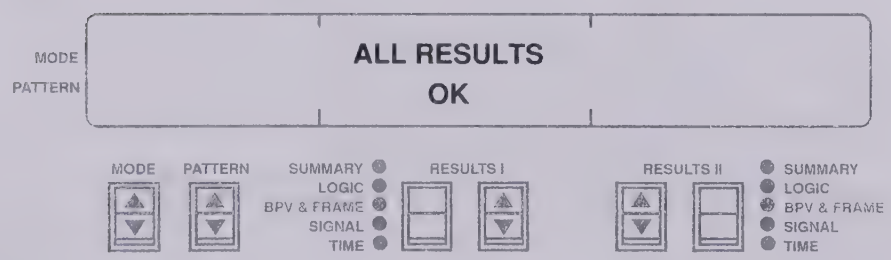
If AUTO LLB does not appear, check that the AUX RESPONSE function is set to AUTO RESPONSE or verify the AUX LP CODE function is set to the correct loop code. Also verify the central office setup.

12. **Loopback and Status LEDs verification**

The loopback is successfully established and these LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

13. **RESULTS I switches**

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



14. **Results interpretation**

00-BIT ERRORS, 25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

50-SPX CURRENT

Depending on the type of office repeater used, the simplex current should read 60, 100, or 140 mA.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end.

Disconnect the T-BERD 211

15. **Send CSU loop-down code from central office to T-BERD 211**

The T-BERD 211 responds by releasing the AUTO LLB mode. The Loop Down LED illuminates when the loop-down code is received. This internally disconnects the receiver from the transmitter. Disconnect the T-BERD 211 from the span.

11.TESTING WITH MULTIPAT AND BRIDGTAP PATTERNS

MULTIPAT™

- Automated test contains five Bellcore approved test patterns to perform a one-step qualification of T1 span lines.
- Includes ALL ONES, 1:7, 2 IN 8, 3 IN 24, and T1-QRSS.

BRIDGTAP™

- Automated test detects the presence of bridge taps on T1 span lines.
- Transmits 21 patterns that are composed of varying degrees of ones and zeros densities.

Figure 13 illustrates the T-BERD 211 configured in a loopback to perform automated MULTIPAT and BRIDGTAP testing.

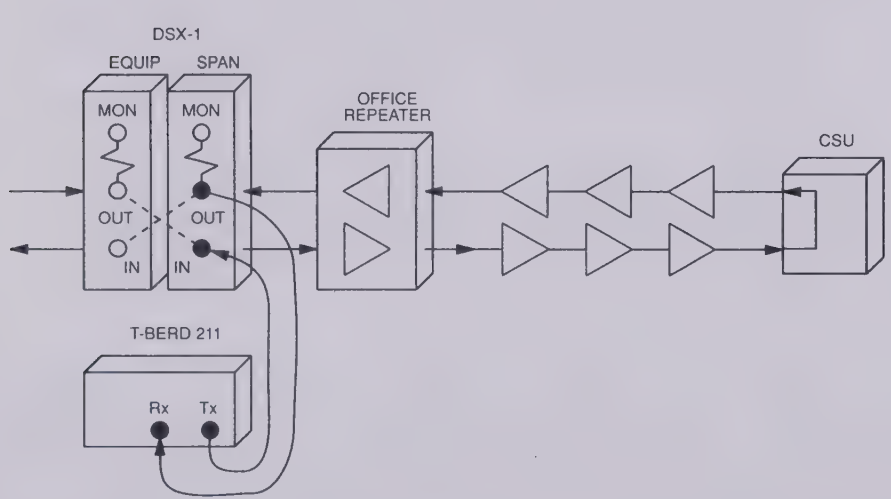
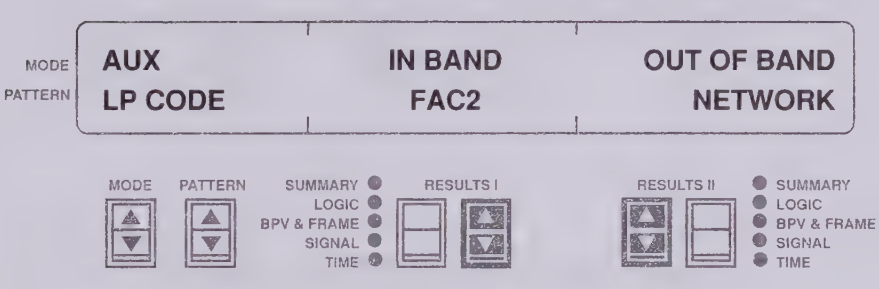


Figure 13
Testing with MULTIPAT and BRIDGTAP

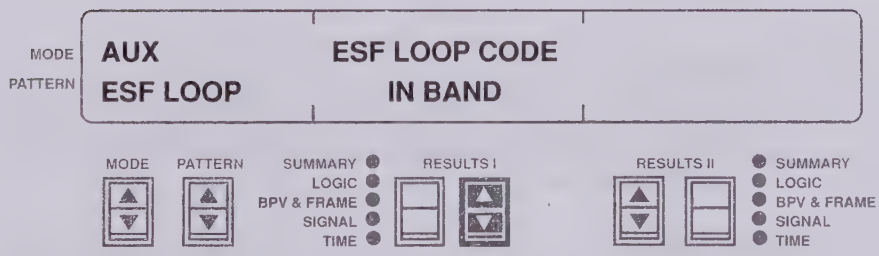
1. **Connect compatible printer (optional)**
   Refer to *Application 1, Generating Printouts*, to connect a printer to the T-BERD 211.

2. **MODE switch**
   Select the AUX mode.

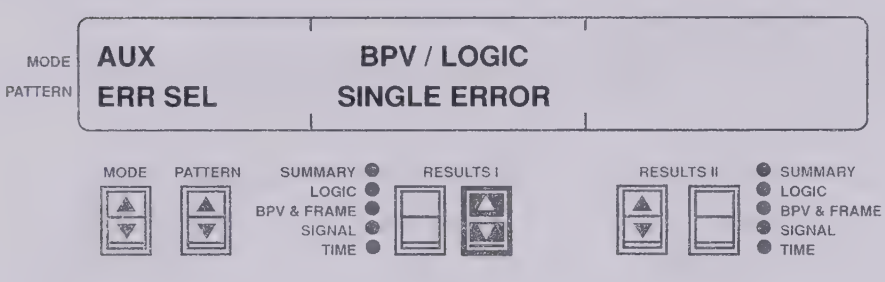
3. **PATTERN switch**
   Select AUX LP CODE to set the appropriate loop code.



If testing T1 ESF circuits, select AUX ESF LOOP to set the loop code type.



Select AUX ERR SEL to set the burst duration to insert a single error.



4. **MODE switch**
   Exit the auxiliary function and select the appropriate T1 network framing format.

5. **PATTERN switch**
   Select either the MULTIPAT or BRIDGTAP test pattern.

6. **TIMING switch**
   Set to INT.

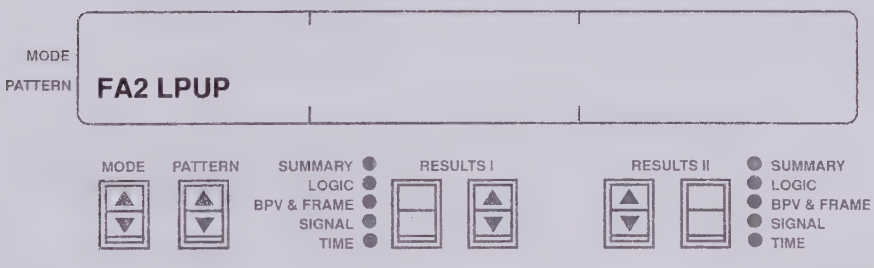
7. **TEST switch**
   Set to CONT. The MULTIPAT test requires a minimum of 15 minutes and the BRIDGTAP test requires a minimum of 11 minutes to complete.

8. **CODE switch**
   The MULTIPAT test can function with either AMI or B8ZS. The BRIDGTAP test should be performed with AMI selected for best results.

9. **RECEIVE INPUT switch and jack**
   Select the TERM input level and connect a cable between this jack and the span-side DSX-1 OUT jack.

10. **TRANSMIT OUTPUT switch and jack**
    Select the 0dB(DSX) output level and connect a cable between this jack and the span-side DSX-1 IN jack.

11. **LOOP UP switch**
    Press this switch to send the loop-up code. The switch and Loop Up LED illuminate until the loop code is detected. A loop-up code message appears in the display. The test restarts when the loopback is established.

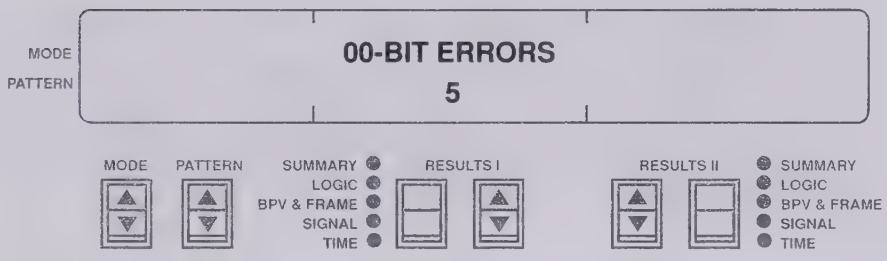


12. **Status LEDs**
    When the loopback is established, these LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable). In the PATTERN window, MULTIPAT or BRIDGTAP alternate with the transmitted test pattern. The test pattern appears in lowercase characters.

13. **RESULTS I Category switch**
    Select the SUMMARY category.

14. **LOGIC ERROR INSERT switch**

Press the switch five times to verify that the logic errors are received and the T1 circuit is looped back.



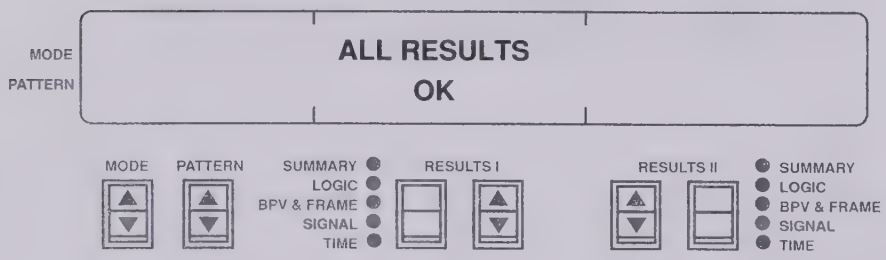
If the loopback is not established, the bit errors do not appear in the display. The failed loopback could be caused by the NIU/CSU not operating correctly, the line from you to the NIU/CSU is bad, or the transmitted loop code is incorrect.

15. **RESTART switch**

Clear the results and start the test.

16. **RESULTS I switches**

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



17. **Results interpretation — SUMMARY category**

ALL RESULTS OK

No errors were detected with the MULTIPAT and BRIDGTAP tests.

PATTERN FAILED (PATTERN NAME)

Test failed at the indicated test pattern.

Errored Results — MULTIPAT Errors

When all or part of the patterns fails, it generally indicates a malfunctioning repeater, multiplexer, or DSX. The span requires further analysis and sectionalization.

Errored Results — BRIDGTAP Errors

When the errors are grouped around a number of patterns it indicates that a bridge tap exists on the span. Sectionalize the span to isolate the bridge tap.

Printing Test Results

18. **PRINT RESULTS switch**

Press this switch to generate a MULTIPAT (see Figure 14) and BRIDGTAP (see Figure 15) results printout.

```
    15MIN PRINT          18:04:50  12 MAR
BIT ERR          1340   ASYN E SEC      802
BER         9.96 E-07   OUT SY SEC        0
SLIPS                0   BPV ERR           0
BPV ER SEC           0   BPV RATE     0 E-09
FRA ER SEC           3   FRA ERR           3
F E RATE       4 E-07   FRA LOS           0
FRA LS SEC           0   SIG LS SC         0
ALARM SEC          372   ELAP TIM  00:15:00
  MULTIPAT RESULTS
PATTERN       BIT ERR   ERR SEC   SYNC SEC
ALL ONES          260   168            175
1:7               271   175            175
2 IN 8            270   167            175
3 IN 24           269   158            175
T1-QRSS           270   134            175
   ALARM/STATUS
ONE DEN HIST       ON   EX ZERO HIST     ON
ALL ONE HIST       ON   T1               ON
PATTERN SYNC       ON   FRAME SYNC       ON
```

Figure 14
Simulated Multipattern Results Printout

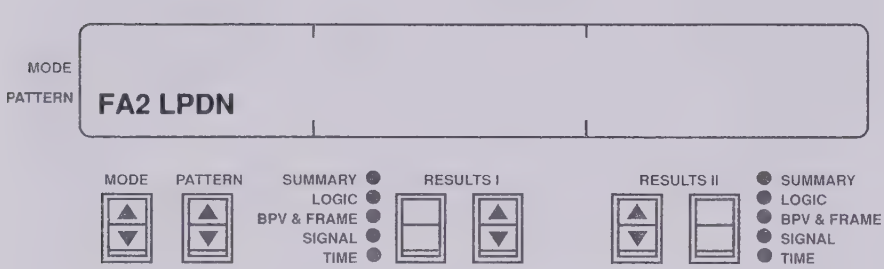
```
    15MIN PRINT          18:04:50  12 MAR
BIT ERR        225423   ASYN E SEC       74
BER          2.13 E-0   OUT SY SEC        0
SLIPS                0  BPV ERR       32301
BPV ER SEC          10  BPV RATE 3.02 E-05
FRA ER SEC          97  FRA ERR        1525
F E RATE    2.12 E-04   FRA LOS           0
FRA LS SEC           0  SIG LS SC         0
ALARM SEC          164  ELAP TIM  00:15:00
BRIDGTAP RESULTS
PATTERN       BIT ERR   ERR SEC  SYNC SEC
ALL ONES            0         0        46
1:1                 0         0        46
1:3                 0         0        46
1:5                 0         0        46
1:6             16123         6        46
1:7             16124         5        46
2:8                 0         0        46
2:9                 0         0        46
2:10                0         0        46
2:11                0         0        24
2:12                0         0        23
2:13                0         0        23
2:14                0         0        23
3 IN 18         54600        18        23
3 IN 19         27903        10        23
3 IN 20         44112        14        23
3 IN 21         49785        16        23
3 IN 22             0         0        23
3 IN 23         16776         5        23
3 IN 24             0         0        23
T1-QRSS             0         0        23
    ALARM/STATUS
ONE DEN HIST       ON   EX ZERO HIST    ON
ALL ONE HIST       ON   T1              ON
PATTERN SYNC       ON   FRAME SYNC      ON
```

Figure 15
Simulated Bridge Tap Results Printout

Disconnect the T-BERD 211

19. **LOOP DOWN switch**

Press this switch to send the loop-down code. The switch and Loop Down LED illuminate until the loopback is released. A loop-down code message appears in the display. Disconnect the T-BERD 211 from the span.



12. MONITORING DS0 CHANNELS
T-BERD T1 CHANNEL MONITOR OPTION REQUIRED

- Display channel signaling information for all 24 channels.
- Monitor DS0 channel through speaker or VF output.

Figure 16 illustrates T-BERD T1 Channel Monitor Option and the T-BERD 211 monitoring the T1 and DS0 signals from the DSX-1 access point.

Connect T1 Channel Monitor To T-BERD 211

1. **T-BERD 211 — turn power off**

2. **Connect coiled cable**
   Connect the T1 Channel Monitor coiled cable to the T-BERD 211 15-pin D connector.

T-BERD 211 Test Setup

3. **MODE switch**
   Select AUTO mode.

4. **TIMING switch**
   Set to RECOVD (LOOP).

5. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

6. **RESTART switch**
   Clear the results and start the test.

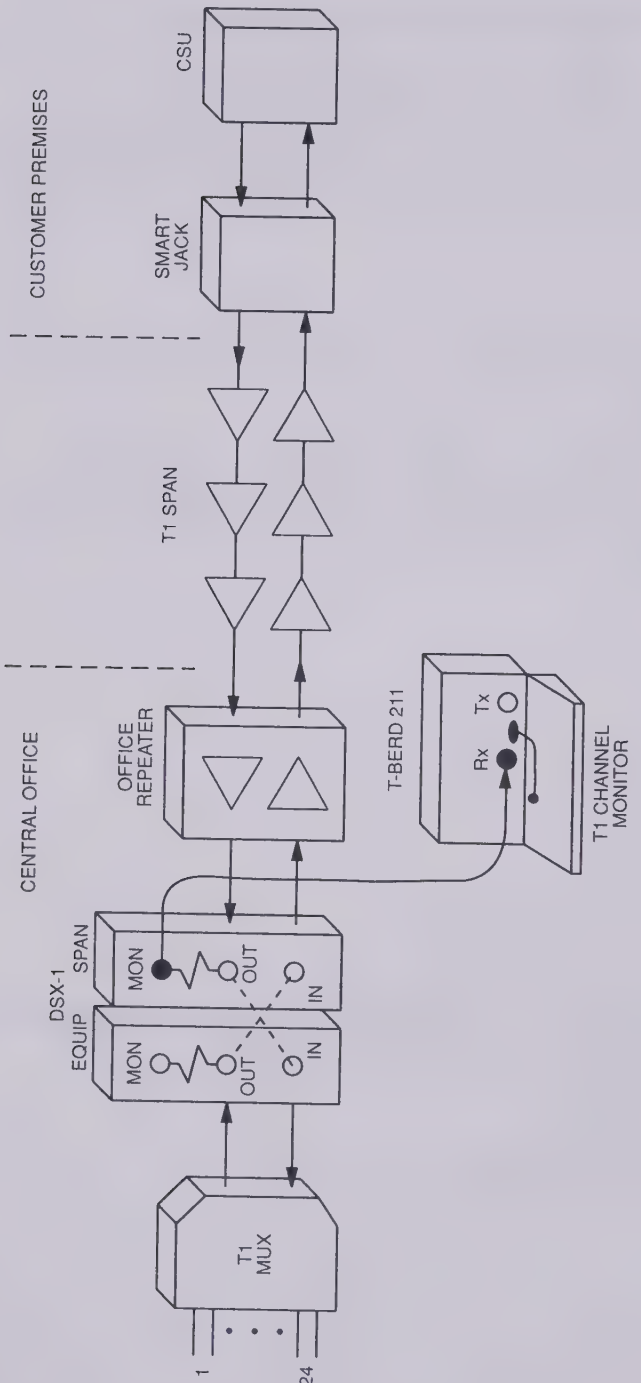


Figure 16
Monitoring T1 and DS0 Signals

7. **MODE/PATTERN window**

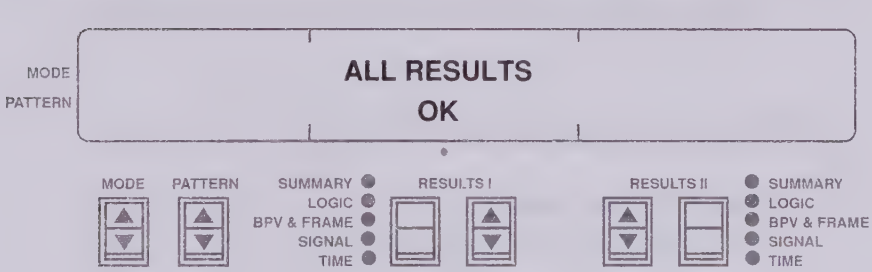
   Verify received framing format and pattern. The framing format and pattern (or live) appear in lowercase characters.

8. **Status LEDs**

   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

9. **RESULTS I switches**

   Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



10. **Results interpretation**

   25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

   These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

   40-RX FREQ, Hz

   The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be -20 dBdsx ±1.5 dBdsx at resistor isolated DSX-1 MON jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end.

T-BERD T1 Channel Monitor Option Test Setup

11. **FRAME FORMAT switch**
    Select the appropriate framing format.

12. **CHANNEL SELECT switch**
    Select the desired DS0 channel.

13. **VOLUME control**
    Adjust the control to mid-level.

14. **Results interpretation**

    SIGNALING Display

    Check the signaling for the selected DS0 channel. The AB signaling bits indicate the signaling status (on/off hook, idle, or ringing) for each DS0 channel for all framing formats. The CD signaling bits are only active with ESF framing.

    Data Bit LEDs

    Monitor the DS0 channel data bits for steady state conditions that can indicate alarms, i.e., Bit 2 is in a steady ON state, Yellow Alarm; all bits are in a steady ON state, Idle signal.

LEVEL (dBm)

Measure the DS0 channel signal level. If the signal level exceeds +3 dBm, the Clipping LED illuminates. On a voice channel, the level varies as the speech pattern changes. It is common to see the Clipping LED flashing. On a data channel, the level should remain constant and the Clipping LED should not flash.

15. **VF OUT jack (optional)**

    Connect a VF test set to the Channel Monitor to further analyze the VF signal of the selected DS0 channel.

16. **RS-232 connection (optional)**

    Connect a test set (e.g., protocol analyzer) to the Channel Monitor to further analyze either the ESF or SLC datalink or DS0 channel data. Select the output with the **DATALINK/CHANNEL** switch.

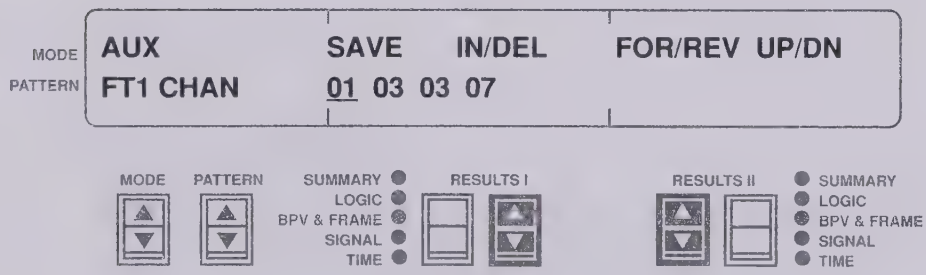
13. MONITORING FT1 PERFORMANCE
FT1 OPTION REQUIRED

- Non-intrusively monitor the FT1 facility.
- Confirms that the contiguous or non-contiguous FT1 signal is properly received by the network equipment.
- Monitor the FT1 signal for BPVs, frame errors, and CRC errors (if applicable).

Figure 17 illustrates the T-BERD 211 monitoring the FT1 signal from the DSX-1 access point.

1. **MODE switch**
   Select the AUX mode.

2. **PATTERN switch**
   Set the AUX FT1 CHAN function for the contiguous or non-contiguous channels.



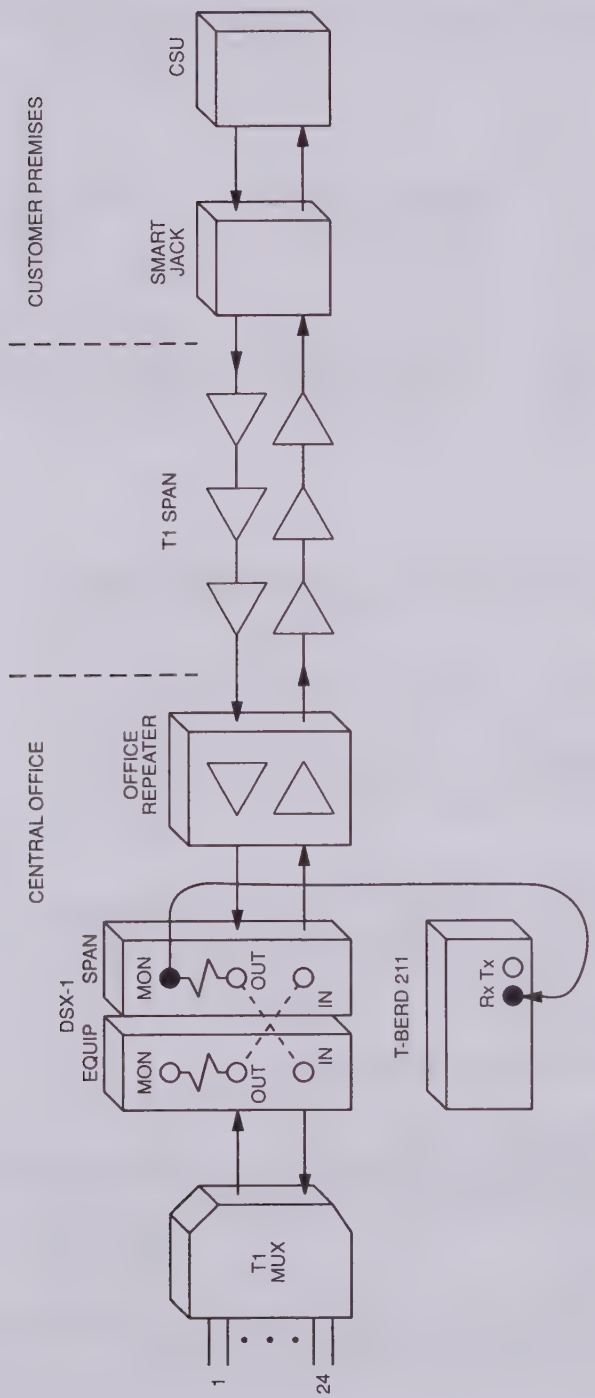
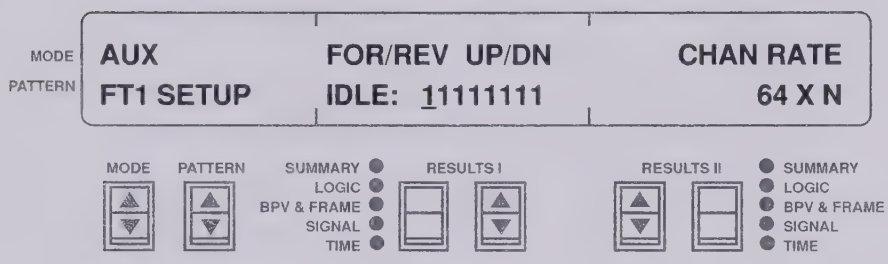


Figure 17
Monitoring FT1 Signal Performance

Set the AUX FT1 SETUP function for the desired idle code and channel rate.



3. **MODE switch**
   Exit the auxiliary functions and select AUTO mode.

4. **TEST switch**
   Set to CONT.

5. **TIMING switch**
   Set to RECOVD (LOOP).

6. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

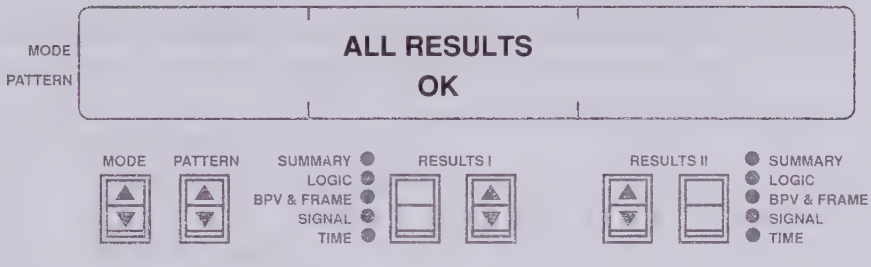
7. **RESTART switch**
   Clear the results and start the test.

8. **MODE/PATTERN window**
   Verify received framing format and pattern. The framing format and pattern (or live) appear in lowercase characters.

9. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

10. **RESULTS I switches**

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



11. **Results interpretation**

25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be -20 dBdsx ±1.5 dBdsx at resistor isolated DSX-1 MON jacks. Incorrect levels could be caused by a faulty line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end.

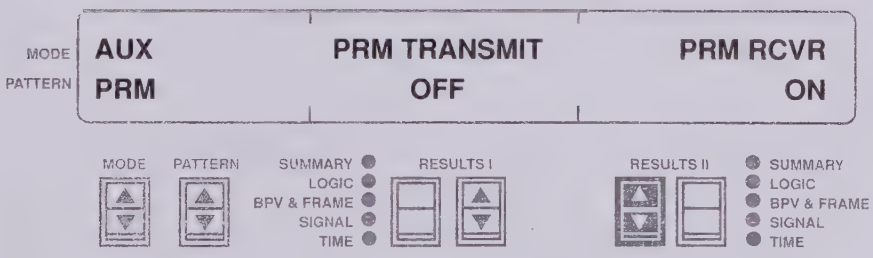
14. MONITORING ESF PRMS
ENHANCED ESF OPTION REQUIRED

- Perform in-service error analysis on T1 ESF circuits.
- Monitor ANSI T1.403 Performance Report Messages (PRMs).

Figure 18 illustrates the T-BERD 211 monitoring a T1 circuit for PRMs from a DSX-1 access point.

1. **MODE switch**
   Select the AUX mode.

2. **PATTERN switch**
   Select AUX PRM and enable the PRM RCVR.



3. **MODE switch**
   Exit the auxiliary function and select the appropriate T1 ESF network framing format or AUTO.

4. **TEST switch**
   Set to CONT.

5. **TIMING switch**
   Set to RECOVD (LOOP).

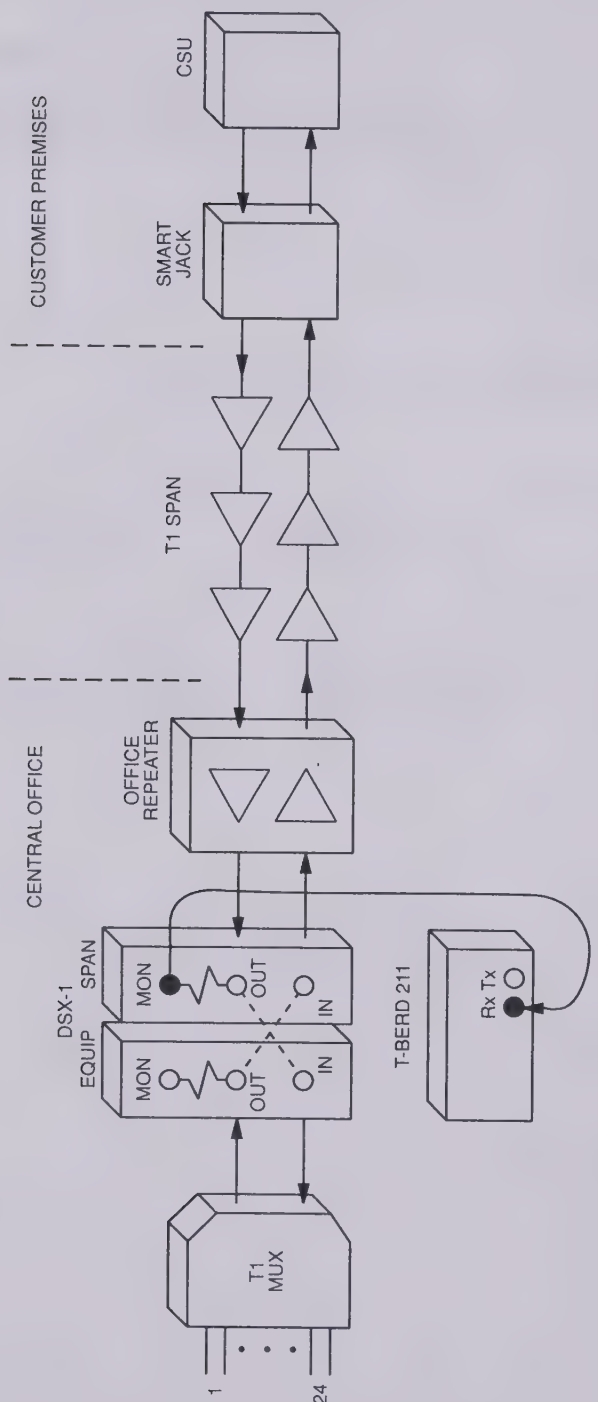


Figure 18
Monitoring T1 ESF Circuit PRMs

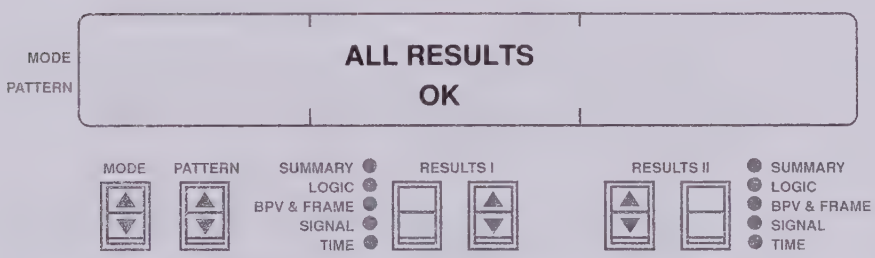
6. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

7. **RESTART switch**
   Clear the results and start the test.

8. **MODE/PATTERN window**
   Verify received framing format and pattern. The framing format and pattern (or live) appear in lowercase characters.

9. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

10. **RESULTS I switches**
    Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



11. **Results interpretation**
    The following results indicate the performance of the received signal at the far-end CSU.

    17-FAR FRM ES
    This result reports on the PRM Frame-Synchronization-Bit Error Event Bit (FE = 1) and indicates the number of seconds in which one or more frame errors occurred in the far-end received signal.

18-FAR FRM SES

This result reports on the PRM Severely-Errored Framing Event Bit (SE = 1) and indicates the number of seconds in which two or more frame errors occurred in less than 3 ms in the far-end received signal.

19-FAR BPV SEC

This result reports on the PRM Line-Code Violation Event Bit (LV = 1) and indicates the number of seconds in which one or more BPVs occurred in the far-end received signal.

20-FAR SLP SEC

This result reports on the PRM Controlled-Slip Event Bit (SL = 1) and indicates the number of seconds in which controlled slips occurred in the far-end received signal.

21-FAR PRM SEC

This result reports the total number of seconds, since test restart, in which a valid PRM was received.

22-FAR CRC ERR

This result reports on the PRM CRC Error Event Bits (G1 to G6) and indicates the minimum number of CRC errors reported in the following 22-FCRC results.

22-FCRC 1 — This result reports on the first PRM CRC Error Event Bit (G1 = 1).

22-FCRC 2-5 — This result reports on the second PRM CRC Error Event Bit (G2 = 1).

22-FCRC 6-10 — This result reports on the third PRM CRC Error Event Bit (G3 = 1).

22-FCRC11-100 — This result reports on the fourth PRM CRC Error Event Bit (G4 = 1).

22-FCRC101-319 — This result reports on the fifth PRM CRC Error Event Bit (G5 = 1).

22-FCRC>319 — This result reports on the sixth PRM CRC Error Event Bit (G6 = 1).

23-PAY SRC

This result identifies the direction of the PRM according to the PRM Command/Response Bit (C/R) and the Payload Loopback Activated Bit (LB). In end-to-end applications, a customer generated PRM is indicated as CUST (C/R = 0 and LB = 0) and a carrier generated PRM is indicated as CARR (C/R = 1 and LB = 0) in the display. In payload loopback applications, the customer generated PRM is indicated as CUST LOOP (C/R = 0 and LB = 1) when the customer is looped back and the carrier generated PRM is indicated as CARR LOOP (C/R = 1 and LB = 1) when the carrier is looped back.

The following results indicate the performance of the received signal at the near-end terminal.

25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

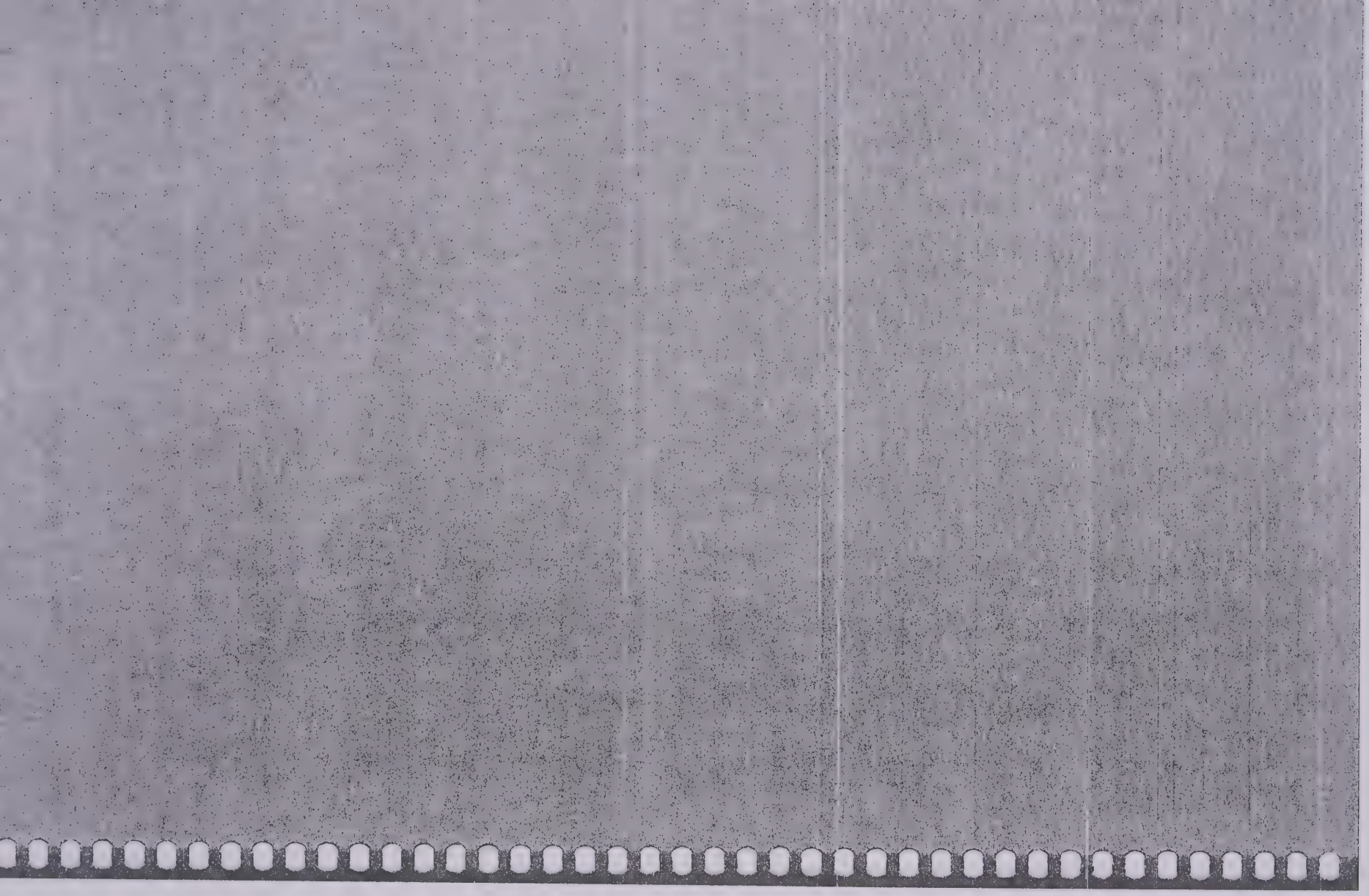
The received level should be -20 dBdsx ±1.5 dBdsx at resistor isolated DSX-1 MON jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end.



15. TESTING FOR SHORTS, OPENS, AND BRIDGE TAPS
TDR OPTION REQUIRED

- Test twisted-pair copper wire for shorts, opens, bridge taps, etc.

Figure 19 illustrates the T-BERD 211 connected to a cable pair to test the line with the TDR.

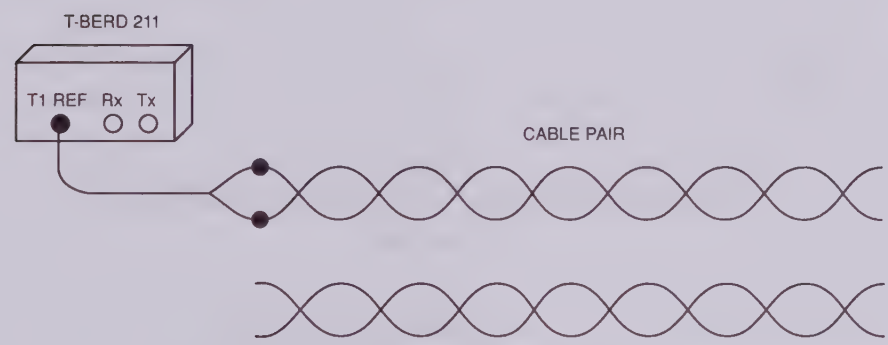


Figure 19
Testing for Shorts, Opens, and Bridge Taps

Testing a Cable Pair with the TDR

Figure 20 illustrates how the TDR GRAPH would appear after the initial test of the cable pair. The GRAPH indicates a bridge tap at 2237 feet (position 1) and an UNREC (unrecognized) fault at 4476 feet (position 2). By selecting Fault 2 from the TDR RESULTS display and pressing PRINT GRAPH again, the magnified trace of Fault 2, shown in Figure 21, can be more clearly viewed. The trace at Fault 2 has the characteristics of a short. To verify the actual fault at Fault 2, remove the bridge tap and repeat the TDR test. Figure 22 clearly identifies the fault as a short, and with the bridge tap removed, the short becomes the first fault down the cable pair.

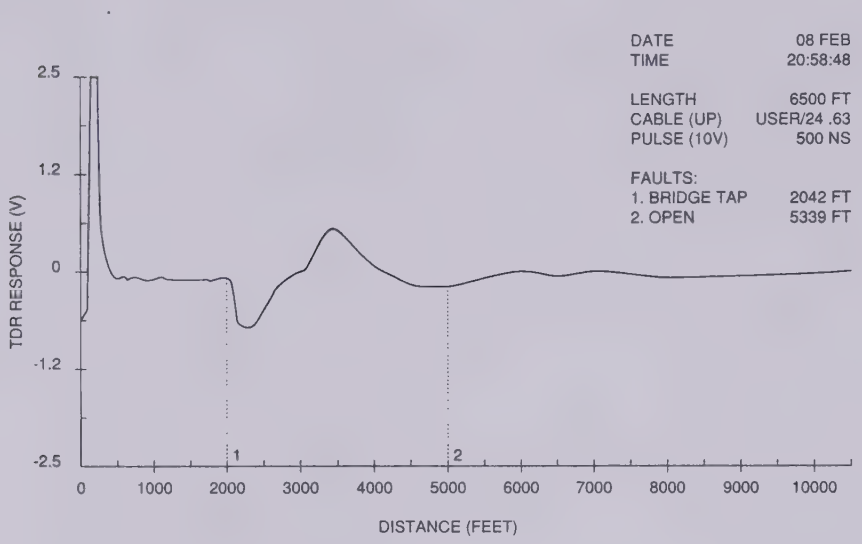


Figure 20
Initial TDR Test Result Graph

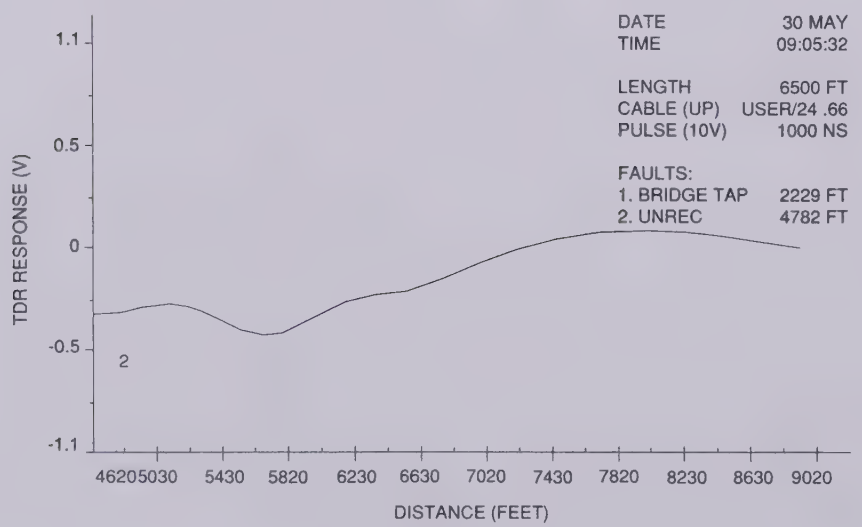


Figure 21
Magnified TDR Graph

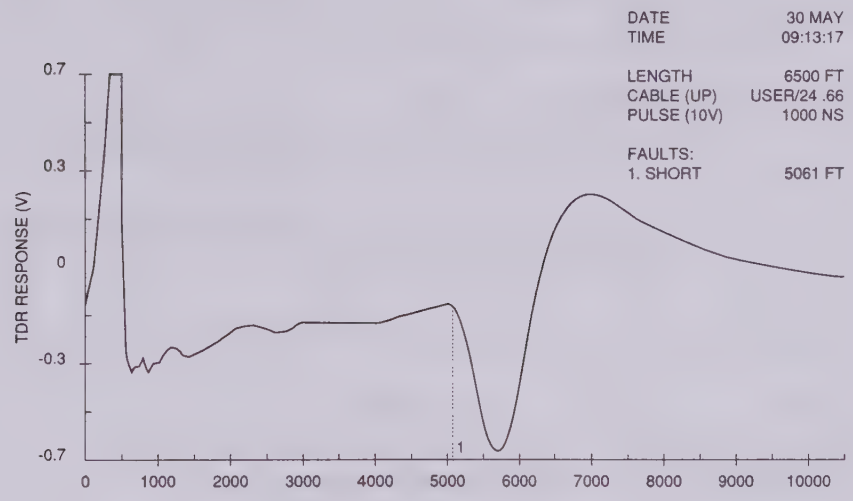


Figure 22
Verifying the Second Cable Pair Fault

1. **Cable pair preparation**
   - Remove all known T1 impairments (bridge taps, coils, etc.).
   - Open both ends of the cable pair. On repeatered spans, remove the repeater and simplex current.

     NOTE: The TDR cannot look past hard opens or shorts multiple faults on a cable pair reduce the effectiveness of the TDR. Therefore, as the faults are located they should be repaired and the line retested.

2. **Connect compatible printer (optional)**
   Refer to *Application 1, Generating Printouts*, to connect a printer to the T-BERD 211.

3. **MODE switch**
   Select TDR mode.

4. **PATTERN switch**
   Select TDR SETUP menu.

5. **RESULTS I Category switch**
Select CABLE type and PR. VEL for the cable pair being tested.

NOTE: The selected CABLE type must match the cable being tested to obtain accurate results.

CABLE	PR. VEL	Description
PIC/22	.67	22 gauge PIC wire.
PIC/24	.66	24 gauge PIC wire.
PIC/26	.65	26 gauge PIC wire.
JELL/22	.62	22 gauge jelly-filled insulated wire.
JELL/24	.61	24 gauge jelly-filled insulated wire.
JELL/26	.60	26 gauge jelly-filled insulated wire.
PULP/22	.71	22 gauge paper-pulp insulated wire.
PULP/24	.70	24 gauge paper-pulp insulated wire.
PULP/26	.68	26 gauge paper-pulp insulated wire.
USER/22	.40 - .99	When the wire gauge and PR. VEL are known for a cable not listed, select the wire
USER/24	.40 - .99	gauge with the **RESULTS I Category** switch and PR. VEL with the **RESULTS I Results** switch in 0.01 steps.
USER/26	.40 - .99	
DEFAULT	.66	If the PR. VEL and CABLE type are unknown, select DEFAULT.

6. **RESULTS II Results switch**
Select LENGTH: 1000, 3000, or 6500 feet. Select AUTO if cable length is unknown.

7. **RESULTS II Category switch**
Toggle display to NO REF (if not already NO REF) to clear reference trace buffer.

8. **T1 REF (TDR) jack**
   Connect test cable between this jack and the cable pair.

9. **RESTART switch**
   Press to start TDR test.

10. **Test verification**
    - *TESTING* flashes in PATTERN window.
    - *RESULTS: NOT AVAILABLE* appears in RESULTS I window.
    - When test is completed, the fault and distance information appears in the RESULTS I window. Up to four faults could be identified at one time.

11. **Cable pair fault analysis**
    - If *FAULT 1: OPEN AT xxxx FEET* appears and the distance is the end of the cable pair, the pair is good. This ends the test.
    - If *FAULT 1: OPEN (or SHORT) AT xxxx FEET* appears and the distance is *not* the end of the cable pair, the pair has a short or open at the indicated distance. Clear the fault and repeat the procedure.
    - If *FAULT 1: NONE* appears, no fault is detected. Either the cable pair is too long for the distance being tested or it is terminated with no impedance mismatch.
    - If *FAULT 1: B-TAP AT xxxx FEET* appears, the pair has a bridge tap at the indicated distance. Clear the fault and repeat the procedure.
    - If *FAULT 1: UNREC AT xxxx FEET* appears, the pair has an unrecognized fault at the indicated distance. Clear the fault and repeat the procedure.

12. **Generate a printout**
    Go to *Print a Single Trace TDR Graph* to generate a single trace GRAPH. Go to *Print a Dual Trace TDR Graph* to generate a dual trace GRAPH. Go to *Print TDR Results and Setup* to generate the TDR results and setup printout.

Print a Single Trace TDR Graph

1. **PATTERN switch**
   Select the TDR SETUP menu and verify that NO REF is displayed.

2. **PATTERN switch**
   Select TDR RESULTS and verify that PRINT GRAPH is displayed.

3. **RESULTS II Category switch**
   Press this switch to PRINT GRAPH. A single trace graph is printed (see Figure 23).

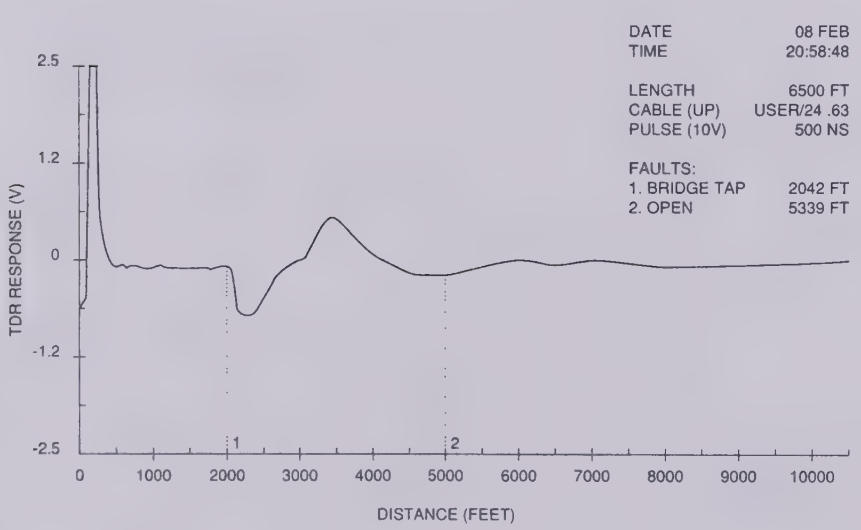


Figure 23
Single Trace TDR Graph

Print a Dual Trace TDR Graph

1. **PATTERN switch**
   Select the TDR SETUP menu and verify that NO REF is displayed.

2. **RESULTS II Category switch**
   Press this switch to store the current trace and verify REF STORED appears.

3. **Select another cable pair and press RESTART switch**
   The second cable pair is tested and the results appear in the display.

4. **RESULTS II Category switch**
   When the TDR RESULTS appear, press this switch to PRINT GRAPH. A dual trace graph is printed (see Figure 24).

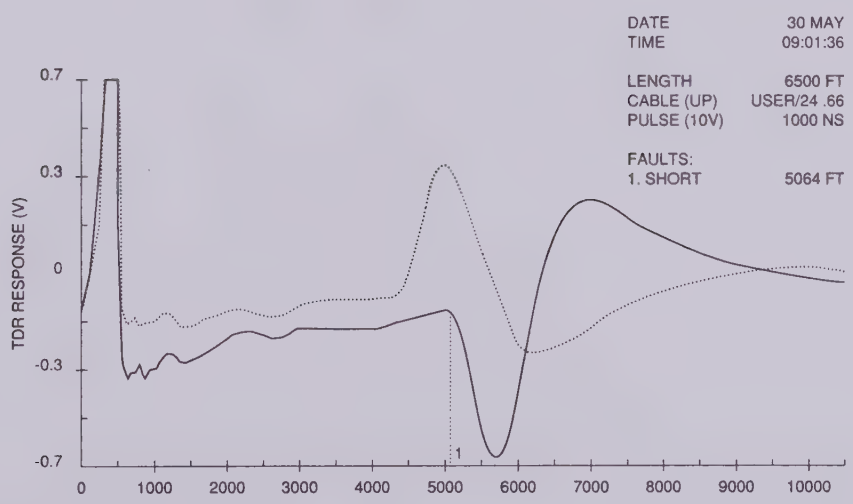


Figure 24
Dual Trace TDR Graph

Print TDR Results and Setup

1. **PRINT switch**
   Press the RESULTS side to print the TDR RESULTS. Press the CONTROLS side to print the TDR SETUP (see Figure 25).

```
TDR CONTROLS PRINT    08:27:50      28 FEB
   SETTINGS:
     LENGTH (FT)      AUTO
     CABLE  (VP)      DEFAULT .66
     REFERENCE        NO



TDR RESULTS PRINT     08:28:27      28 FEB
  FAULTS:
1. B-TAP at    2580 feet
2. OPEN  at    3640 feet
```

Figure 25
TDR Controls and Results Printouts

16. TESTING FROM THE MDF *T-BERD REPEATER POWER SUPPLY REQUIRED*

- Power a T1 span line from the main distribution frame (MDF).
- Measure the current and voltage across a T1 span line.
- Provide the T-BERD 211 access to the T1 span line from the MDF.

WARNING: It is of the upmost importance that the T-BERD Repeater Power Supply be operated by qualified technicians only in accordance with the safety warnings and instructions contained in this manual and printed on the front panel of the unit. Failure to do so could result in serious personal injury. Carefully read the safety information in Section 4 of the *T-BERD 211 Reference Manual* before operating the T-BERD Repeater Power Supply.

Figure 26 illustrates the test setup for the T-BERD Repeater Power Supply and T-BERD 211 at the MDF.

T-BERD Repeater Power Supply Test Setup

WARNING: Do not apply power to the T-BERD Repeater Power Supply until instructed to do so. When power is applied to the T-BERD Repeater Power Supply there is a 350 VDC potential across the terminals, which can cause personal injury.

1. **Connect Mainframe Interconnect Cable**
   Connect the T-BERD Repeater Power Supply Mainframe Interconnect Cable to the T-BERD 211 15-pin D connector.

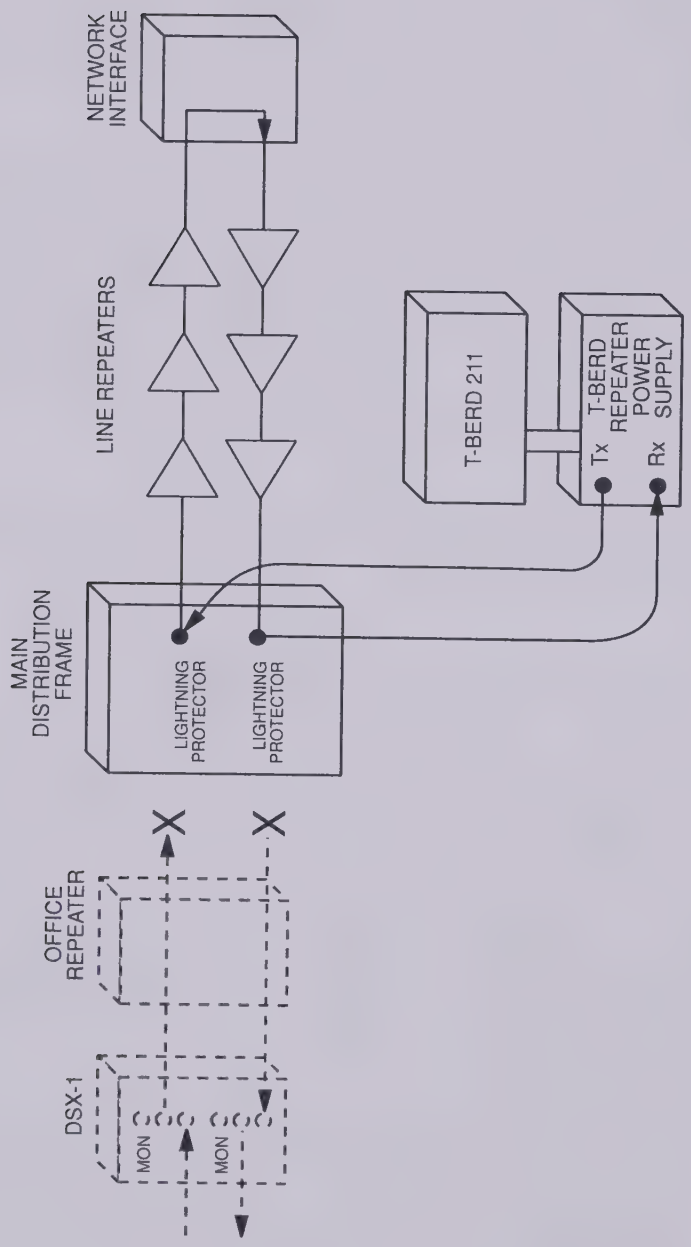


Figure 26
Test Setup at the MDF

2. **Connect the dual WECO 310 or bantam test cords**

   Insert dual WECO 310 or dual bantam test cords into the appropriate transmit and receive jacks on the T-BERD Repeater Power Supply front panel. Connections to the central office distribution frame should be made with a W4CJ test access cord for 303-type protection blocks or a W4BR test access cord for 302-type and 308-type protection blocks.

3. **Remove MDF lightning protectors**

   Remove the MDF lightning protectors from the cable pairs being tested. Insert the transmit and receive cord connectors from the T-BERD Repeater Power Supply into the positions vacated by the lightning protectors.

4. **60 mA 100 mA 140 mA Current switch**

   Select the appropriate current level. The appropriate current setting is determined by the type of repeaters in the circuit being tested. The typical selection is 60 mA.

5. **T-BERD Repeater Power Supply AC power**

   Connect a power cord from the T-BERD Repeater Power Supply into a 120 VAC power outlet. Make sure the **AC Power** switch is turned OFF.

6. **Apply power to the T-BERD Repeater Power Supply**

   When power is applied to the T-BERD Repeater Power Supply, the red High Voltage LED flashes. This indicates that current is passing through the T-BERD Repeater Power Supply. If the red High Voltage LED continues to flash, the current path can not be established, check for an open circuit or other possible wiring fault.

   When the circuit current path is established, the red High Voltage LED remains on continuously. The VOLTAGE and CURRENT displays reflect the current and voltage on the circuit.

To determine if the measured voltage is correct for the span being tested, calculate the expected span line voltage drop with the following formula. The V_{rpt} and V_{drop} can be found in Tables 2 and 3 respectively.

Total V_{drop} = (# repeaters X V_{rpt}) + (V_{drop} X kft of cable)

- If the transmit and receive connections are reversed, the measured voltage will be much less than the expected voltage. Typically, V_{rpt}, when current is reversed, is between 1 and 2 volts.

- Allow for any extra voltage drop required for office repeaters and NIUs. The typical voltage drop for transmission devices is 8 to 16 volts each.

- Allow for additional CSU voltage drops of 14 to 24 volts.

Table 2
Typical Repeater Voltage Drop

	Voltage Drop/Repeater (V_{rpt})		
Repeater Type	**60 mA**	**100 mA**	**140 mA**
238 A/B	7.0	7.1	7.2
239 A/B	7.6	8.2	8.7
239E	8.4	9.6	10.7

Table 3
Typical Cable Gauge Voltage Drop

	Voltage Drop/kft (V_{drop})		
Cable Gauge	**60 mA**	**100 mA**	**140 mA**
26	2.7	4.5	6.3
24	1.7	2.8	4.0
22	1.1	1.8	2.6
19	0.5	0.8	1.2

T-BERD 211 Test Setup

7. **T-BERD 211 AC power**
   Apply power to the T-BERD 211.

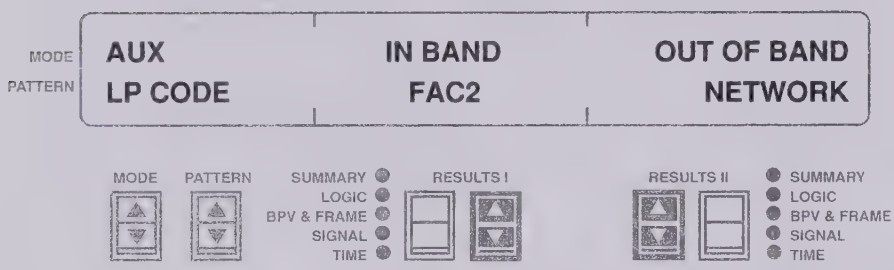
8. **RECEIVE INPUT switch**
   Set the **RECEIVE INPUT** switch to the TERM position.

9. **TRANSMIT OUTPUT switch**
   Set the **TRANSMIT OUTPUT** switch to achieve the desired line build-out. The typical setting is -7.5 dB. The desired setting may be calculated such that the sum of the signal level measurement (41-RX LEVEL) and the selected line build-out is between -15 dBdsx and -22.5 dBdsx.

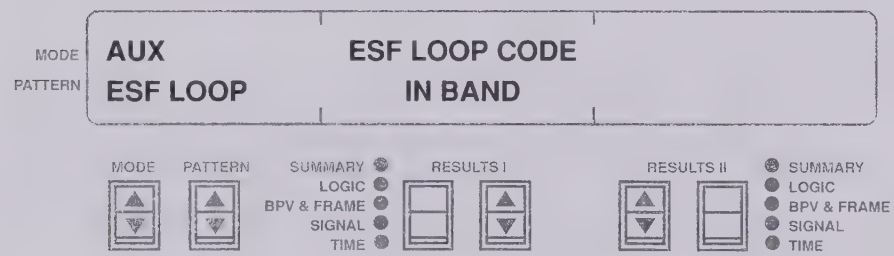
10. **MODE switch**
    Select the AUX mode.

11. PATTERN switch

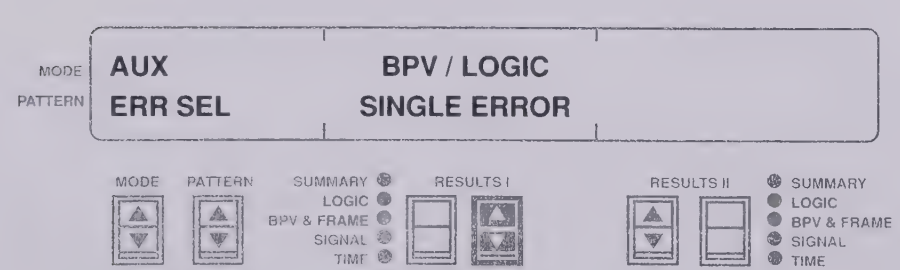
Select AUX LP CODE to set the appropriate loop code.



If testing T1 ESF circuits, select AUX ESF LOOP to set the loop code type.



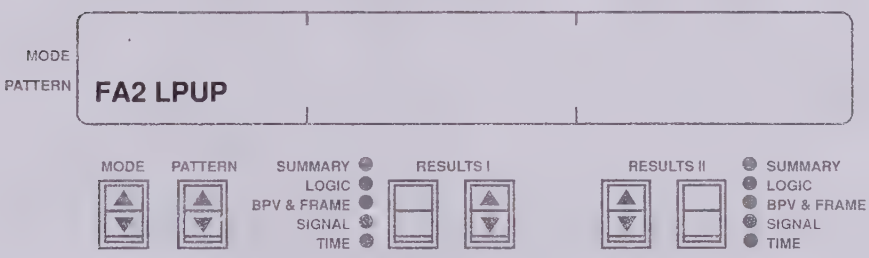
Select AUX ERR SEL to set the burst duration to insert a single error.



12. **MODE switch**
    Exit the auxiliary function and select the appropriate T1 network framing format.

13. **PATTERN switch**
    Select the appropriate test pattern.

14. **LOOP UP switch**
    Press this switch to send the loop-up code. The switch and Loop Up LED illuminate until the loop code is detected. A loop-up code message appears in the display. The test restarts when the loopback is established.

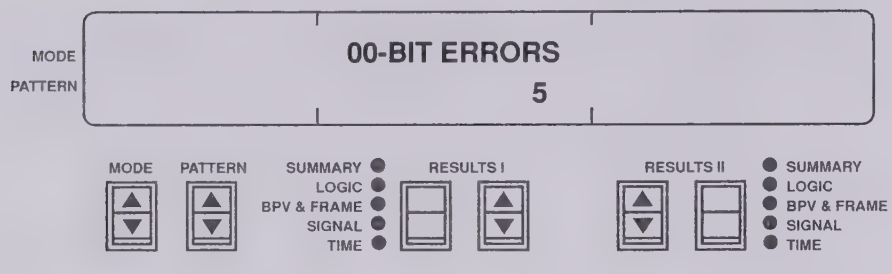


15. **Status LEDs**
    When the loopback is established, these LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

16. **RESULTS I Category switch**
    Select the SUMMARY category.

17. LOGIC ERROR INSERT switch

Press the switch five times to verify that the logic errors are received and the T1 circuit is looped back.



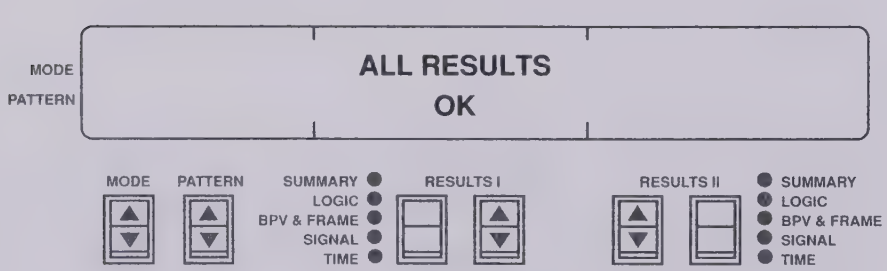
If the loopback is not established, the bit errors do not appear in the display. The failed loopback could be caused by the NIU/CSU not operating correctly, the line from you to the NIU/CSU is bad, or the transmitted loop code is incorrect.

18. RESTART switch

Clear the results and start the test.

19. RESULTS I switches

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



20. **Results interpretation**

00-BIT ERRORS, 25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be +4 to -4 dBdsx at the terminated DSX-1 OUT jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

NOTE: If the Loopback Connector is going to be used as a hard loopback at the MDF, the signal level must be -15 dBdsx or greater to support the loopback signal.

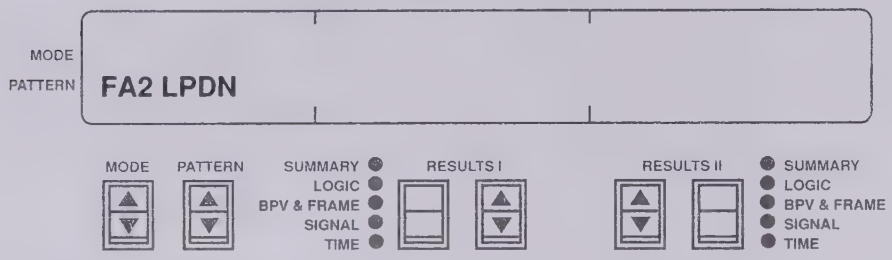
All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end. If MULTIPAT or BRIDGTAP is being used, the LED will illuminate when the ALL ONES pattern is transmitted and received.

Disconnect the T-BERD 211

21. **LOOP DOWN switch**

Press this switch to send the loop-down code. The switch and Loop Down LED illuminate until the loopback is released. A loop-down code message appears in the display. Disconnect the T-BERD 211 from the span.



Disconnect the T-BERD Repeater Power Supply

22. **T-BERD Repeater Power Supply AC power**
When you have completed testing the circuit, turn the T-BERD Repeater Power Supply **AC Power** switch OFF.

WARNING: Verify that power has been removed from the T-BERD Repeater Power Supply. Disconnecting the test cords from the T-BERD Repeater Power Supply or the MDF before removing power from the the T-BERD Repeater Power Supply creates a 350 VDC potential across the terminals, which can cause personal injury.

23. **Disconnect from the MDF lightning protectors**
When the red High Voltage LED is no longer illuminated, remove the test cords from the distribution frame and replace the lightning protectors.

24. **Disconnect the dual WECO 310 or bantam test cords**
Remove the dual WECO 310 or dual bantam test cords from the T-BERD Repeater Power Supply jacks.

25. **T-BERD 211 AC power**
Remove power from the T-BERD 211.

26. **Disconnect Mainframe Interconnect Cable**
Disconnect the Mainframe Interconnect Cable from the T-BERD 211 15-pin D connector.

17. TESTING FROM MID-SPAN
T-BERD 211 AND T-BERD REPEATER POWER SUPPLY REQUIRED

- Loopback the T1 span line at the MDF and test from mid-span.
- Power a T1 span line from the MDF.

WARNING: It is of the upmost importance that the T-BERD Repeater Power Supply be operated by qualified technicians only in accordance with the safety warnings and instructions contained in this manual and printed on the front panel of the unit. Failure to do so could result in serious personal injury. Carefully read the safety information in Section 4 of the *T-BERD 211 Reference Manual* before operating the T-BERD Repeater Power Supply.

Figure 27 depicts the test setup of the T-BERD Repeater Power Supply at the MDF and the T-BERD 211 at mid-span.

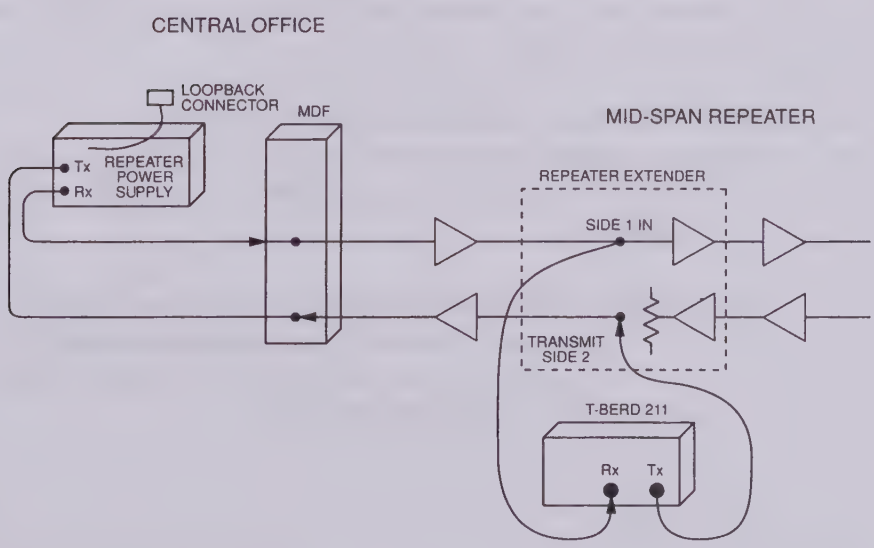


Figure 27
Testing from Mid-Span

Main Distribution Frame Setup

1. **T-BERD Repeater Power Supply test setup**
   Perform Steps 1 through 6 in *Application 16, Testing from the MDF*, to configure the T-BERD Repeater Power Supply at the MDF.

2. **T-BERD 211 test setup**
   Perform Steps 7 through 21 in *Application 16, Testing from the MDF*, to configure the T-BERD 211 and test the span from the MDF.

3. **T-BERD Repeater Power Supply AC Power Switch**
   Turn the AC power OFF.

4. **T-BERD Repeater Power Supply Mainframe Interconnect Cable**
   Disconnect the Mainframe Interconnect Cable from the T-BERD 211 15-pin D connector.

5. **T-BERD Repeater Power Supply Loopback Connector**
   Connect the 15-pin D Loopback Connector to the Mainframe Interconnect Cable.

6. **T-BERD Repeater Power Supply AC Power Switch**
   Coordinate the setup with the mid-span technician before applying AC power. Apply power after the mid-span setup is configured.

   WARNING: Notify the technician at the mid-span point when the span is powered. An unterminated cable pair can have a potential of 350 VDC across it, which can cause personal injury.

Test From Mid-Span

7. **Connecting the T-BERD 211 to the line**

   Connect the T-BERD 211 to the span using the T-BERD Repeater Extender as described in *Application 3, Connecting the T-BERD 211 at Mid-Span.*

8. **Test T1 span**

   With the exception of establishing the loopback with the T-BERD 211, perform one of the loopback applications described in this user's guide to test the span.

Disconnect Test Equipment

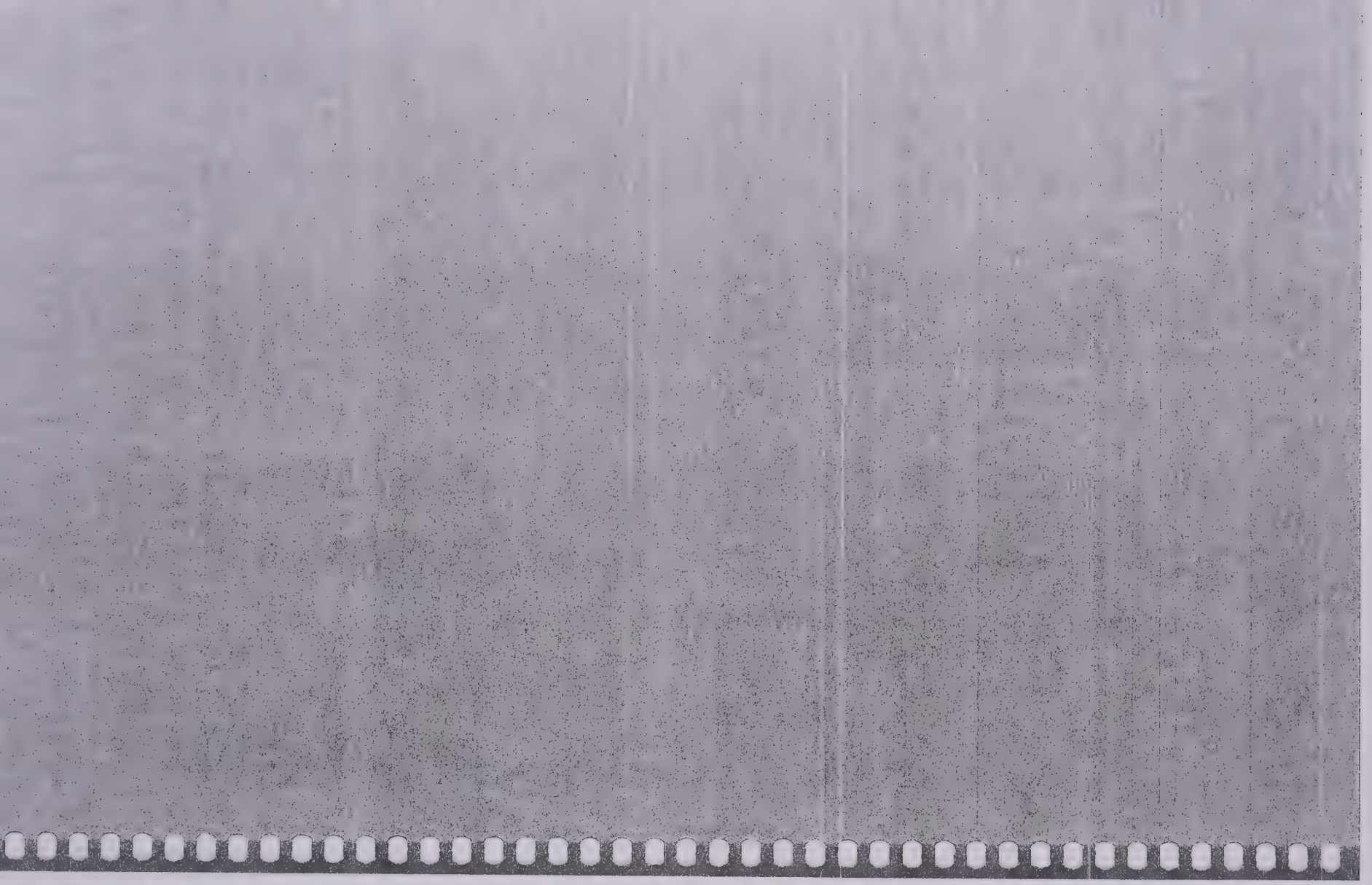
9. **T-BERD Repeater Power Supply**

   Remove power from the T-BERD Repeater Power Supply first. When the red High Voltage LED is no longer illuminated, remove the test cords from the distribution frame and replace the lightning protectors.

   WARNING: Verify that power has been removed from the T-BERD Repeater Power Supply. Disconnecting the test cords from the T-BERD Repeater Power Supply or the MDF before removing power from the the T-BERD Repeater Power Supply creates a 350 VDC potential across the terminals, which can cause personal injury.

10. **T-BERD 211**

    Disconnect the T-BERD 211 from the span.



18. MONITORING DLC SHELF OPERATION
T-BERD DLC ANALYZER OPTION REQUIRED

- Perform non-intrusive monitoring of the DLC shelf datalink and DS0 channels.
- Monitor the datalink traffic between the Central Office Switch (COS) or Central Office Terminal (COT), and the Remote Terminal (RT) for major, minor, and power/miscellaneous alarms, as well as switch to protect and maintenance tests.
- Monitor DS0 channel signaling in both directions and capture DTMF dialed digits.

Figure 28 illustrates the T-BERD DLC Analyzer Option monitoring the DLC Shelf A T1 datalink and DS0 channels from the DSX-1 access point.

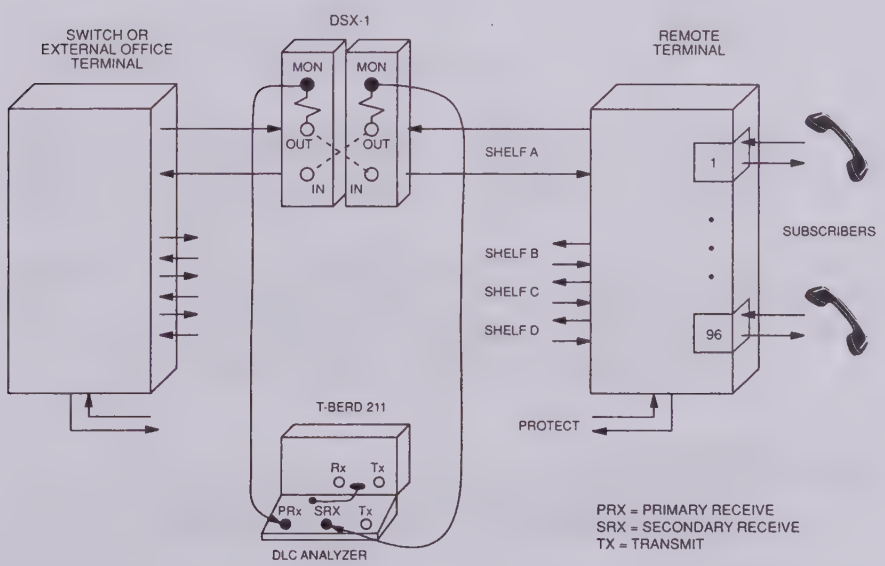


Figure 28
Monitoring DLC Shelf Operation

Connect DLC Analyzer Option To T-BERD 211

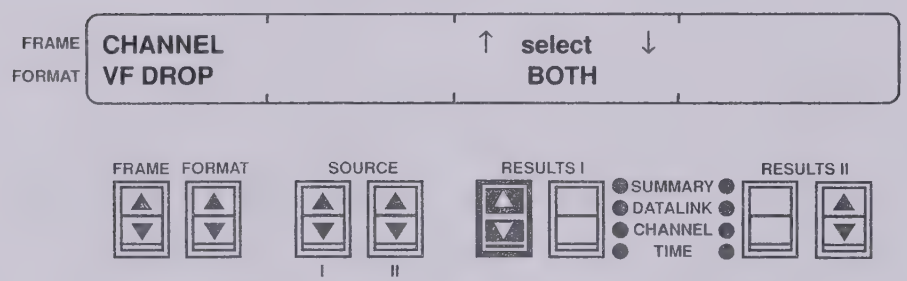
1. **T-BERD 211 — turn power off**

2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to the T-BERD 211 15-pin D connector.

3. **T-BERD 211 — turn power on**

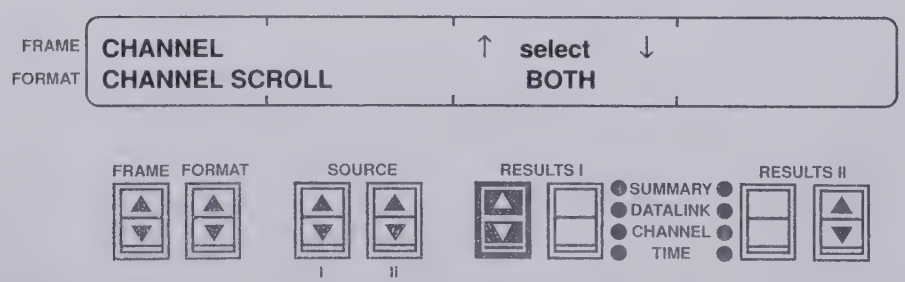
T-BERD DLC Analyzer Option Test Setup

4. **AUX/FRAME/FORMAT switch**
   Select the CHANNEL/VF DROP auxiliary function to set which T1 line the DS0 channel is dropped from.



Set for PRIMARY to drop the DS0 channel from the PRIMARY RECEIVE T1 signal. Set for SECONDARY to drop the DS0 channel from the SECONDARY RECEIVE T1 signal. Set for BOTH to drop the DS0 channel from BOTH T1 signals.

5. **FORMAT switch**
   Select the CHANNEL/CHANNEL SCROLL auxiliary function to set the **PRIMARY** and **SECONDARY CHANNEL** switch control.



Set for BOTH to scroll the **PRIMARY** and **SECONDARY CHANNEL** switch numbers simultaneously. Set for SEPARATE to scroll the switch numbers independently.

6. **AUX switch**
   Exit the auxiliary functions.

7. **FRAME switch**
   Select AUTO mode.

8. **CODE switch**
   Select the appropriate coding.

9. **RECEIVE INPUT switch and PRIMARY RECEIVE jack**
   Select the DSX-MON input level and connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

10. **SECONDARY RECEIVE jack**
    Connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

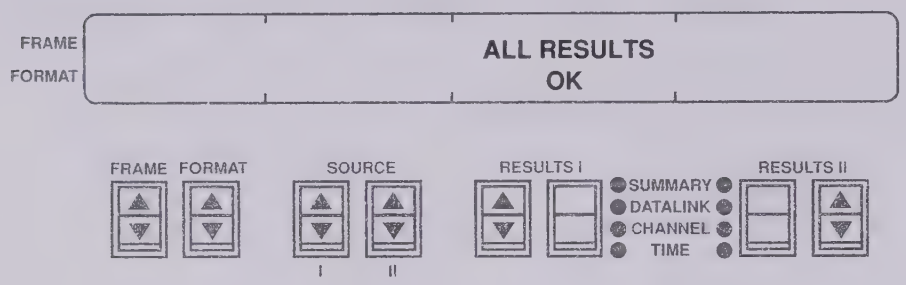
11. **RESTART switch**
    Clear the results and start the test.

12. **FRAME/FORMAT window**
    Verify that the framing format is detected and recognized.

    NOTE: When synchronizing to the SLC-96 framing in AUTO mode, the T-BERD DLC Analyzer automatically defaults to the SLC-M1 mode. The SLC-M2 mode must be selected manually with the **FRAME** switch.

13. **Status LEDs**
    These LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarms LED may illuminate.

14. **RESULTS I switches**
    Check SUMMARY category. If errors or alarms are not detected, *ALL RESULTS OK* appears. If errors or alarms are detected, scroll through the SUMMARY category for specific errors or alarms. Check the other categories as required.



15. **Datalink results interpretation**

Flashing Messages — P/S DATALINK SYNC LOSS and SW PROT FAILED

These messages occur when the T-BERD DLC Analyzer loses datalink synchronization, T1 signal, or switch to protect fails. These messages only appear in the SUMMARY category.

Alarm Messages — P/S FE LOOP PROTECT, P/S FE LOOP SHELF x, P/S MAJOR NO SHELF, P/S MAJOR SHELF x, P/S ALARM SHELF x, P/S MINOR, P/S PWR/MISC, P/S SHELF x ON PROT

These alarms provide information on the condition of the shelves. These messages also appear in the DATALINK category as a historical record of the indicated events.

Maintenance Test Messages — P/S MAINT HOOK/SEIZE, P/S MAINT PROCEED, P/S MAINT TEST ALARM

These messages occur when a maintenance test is being performed. The messages are displayed long enough to see that the operation is in progress; the actual sequence takes less than two seconds. These messages also appear in the DATALINK category as a historical record of the indicated events.

16. **T1 signal results interpretation**

P/S SIGNAL LOSS, P/S VIOLATION, P/S FRM ERROR, and P/S CRC ERROR (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument. These messages only appear in the SUMMARY category.

17. **PRIMARY CHANNEL or SECONDARY CHANNEL switch**
    Press either switch to select a DS0 channel. Verify the setting of the CHANNEL/CHANNEL SCROLL auxiliary function.

18. **DS0 channel results interpretation**
    P/S VF LEVEL, P/S VF FREQ, P/S DATA BITS, and DTMF SEQ
    Verify that the VF signal level and frequency are within specifications. Verify that a data bit is not stuck. Monitor the DTMF dialing sequences.

    P/S TRAFFIC CHANNEL AB, P/S TRAFFIC CHANNEL ABCD, P/S TRAFFIC TIMESLOT AB, and P/S TS CH
    For all framing formats except SLC-M2, monitor the channel signaling bits. For the SLC-M2 framing format, monitor the timeslot signaling and the timeslot channel assignments.

19. **VOLUME control**
    Adjust the control to monitor the selected DS0 channel(s) through the speaker. Verify the setting of the CHANNEL/VF DROP auxiliary function.

20. **VF OUT jack**
    Connect a TIMS test set to the T-BERD DLC Analyzer to perform additional testing and analysis on the selected DS0 channel. Verify that the CHANNEL/VF DROP auxiliary function is set for PRIMARY or SECONDARY, not BOTH.

19. IN-SERVICE REMOTE TERMINAL VERIFICATION
T-BERD DLC ANALYZER OPTION REQUIRED

- Verify the major, minor, and power/miscellaneous alarm response capabilities of the remote terminal (RT).
- Verify the far-end loopback response capability of the RT.
- Verify the maintenance test sequence capability for access to and availability of a Mode 1 bypass pair.

Figure 29 illustrates the T-BERD DLC Analyzer Option testing the RT from the DSX-1 access point.

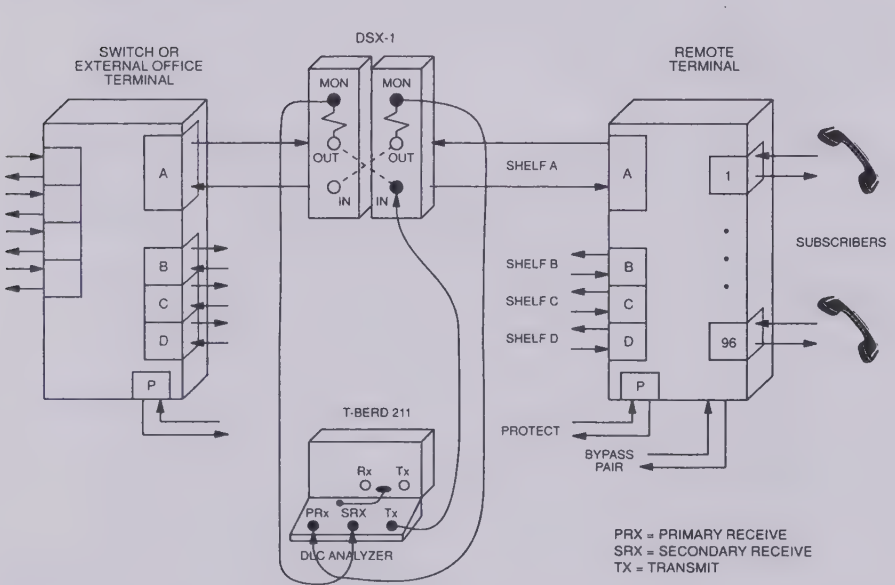


Figure 29
In-Service Remote Terminal Verification

Connect DLC Analyzer Option To T-BERD 211

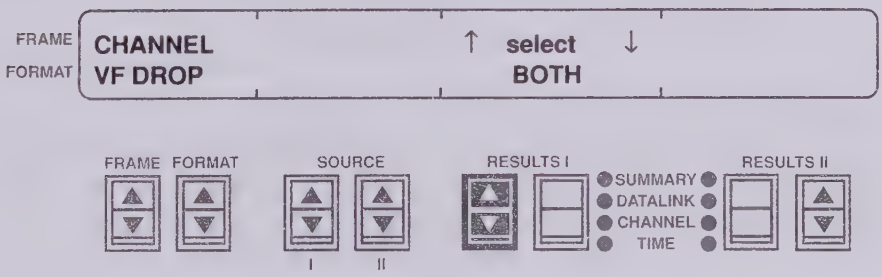
1. **T-BERD 211 — turn power off**

2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to the T-BERD 211 15-pin D connector.

3. **T-BERD 211 — turn power on**

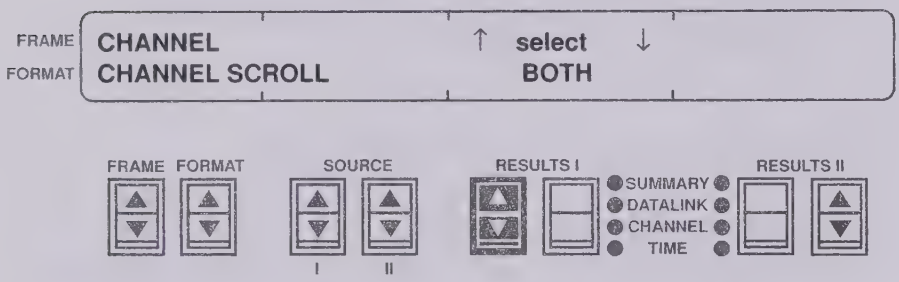
T-BERD DLC Analyzer Option Test Setup

4. **AUX/FRAME/FORMAT switch**
   Select the CHANNEL/VF DROP auxiliary function to set which T1 line the DS0 channel is dropped from.



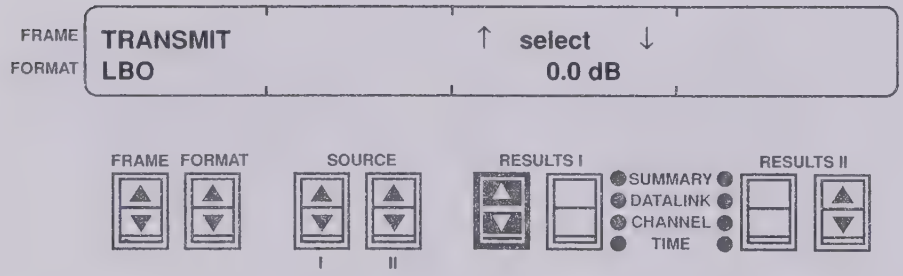
Set for PRIMARY to drop the DS0 channel from the PRIMARY RECEIVE T1 signal. Set for SECONDARY to drop the DS0 channel from the SECONDARY RECEIVE T1 signal. Set for BOTH to drop the DS0 channel from BOTH T1 signals.

5. **FORMAT switch**
   Select the CHANNEL/CHANNEL SCROLL auxiliary function to set the **PRIMARY** and **SECONDARY CHANNEL** switch control.



   Set for BOTH to scroll the **PRIMARY** and **SECONDARY CHANNEL** switch numbers simultaneously. Set for SEPARATE to scroll the switch numbers independently.

6. **FRAME switch**
   Select TRANSMIT/LBO to set the LBO level. If transmitting into the span, set the LBO for 0.0 dB. If transmitting into the equipment, set the LBO for -15.0 dB.



7. **AUX switch**
   Exit auxiliary functions.

8. **FRAME switch**
   Select SLC-M1 mode.

9. **FORMAT switch**
   Select DATLINK format.

10. **CODE switch**
    Select the appropriate coding.

11. **RECEIVE INPUT switch and PRIMARY RECEIVE jack**
    Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

    - If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.
    - If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

12. **SECONDARY RECEIVE jack**
    Connect a cable between this jack and the T1 line as follows:

    - If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.
    - If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

13. **TRANSMIT jack**
    Connect the cable to the T-BERD DLC Analyzer first, then connect the cable as follows:

    - If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 IN jack.
    - If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 IN jack.

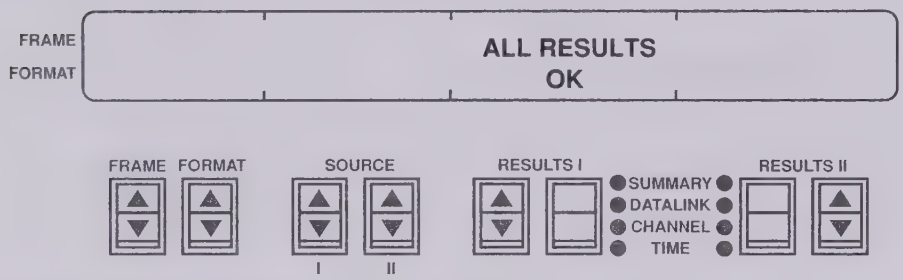
    NOTE: You may notice a brief glitch in the T1 signal when the cable is connected to the DSX-1 IN jack.

14. **RESTART switch**
    Clear the results and start the test.

15. **Status LEDs**
    Both primary and secondary LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarms LED may illuminate.

16. **RESULTS I switches**

Check SUMMARY category. If errors or alarms are not detected, *ALL RESULTS OK* appears. If errors or alarms are detected, scroll through the SUMMARY category for specific errors or alarms. Check the other categories as required.



Testing the Remote Terminal

The following procedures test the remote terminal alarm detection, shelf loopback, and maintenance test capabilities.

Verify Alarm Detection

1. **SOURCE I and II switches**

Select one of the following alarms and shelves:

SOURCE I	MAJOR	MINOR	PWR/MISC
SOURCE II	SHELF A		
	SHELF B		
	SHELF C		
	SHELF D		
	NO SHELF		

2. **INSERT switch**

Press this switch to insert and send the selected alarm to the RT. The switch LED illuminates while in the insert mode.

3. **Datalink results interpretation**

   P/S MAJOR NO SHELF, P/S MAJOR SHELF x, P/S ALARM SHELF x, P/S MINOR, and P/S PWR/MISC

   These alarms should be indicated at the RT and verified with the T-BERD DLC Analyzer. These messages also appear in the DATALINK category as a historical record of the indicated events.

4. **INSERT switch**

   Press this switch to stop sending the alarm to the RT. The switch LED goes out.

Verify Far-End Loopback Capability

1. **SOURCE I and II switches**

   Select the shelf to be looped back.

   SOURCE I FE LOOP

   SOURCE II SHELF A
   SHELF B
   SHELF C
   SHELF D
   PROTECT

2. **INSERT switch**

   Press this switch to insert and send the selected command to the RT. The switch LED illuminates while in the insert mode.

   NOTE: When the far-end loopback command is transmitted, it is automatically preceded by a switch to protection line command to prevent an interruption of the selected shelf.

3. **Datalink results interpretation**

   P/S FE LOOP PROTECT, P/S FE LOOP SHELF x, P/S SHELF x ON PROT, and SW PROT FAILED

   These alarms should be indicated at the RT and verified with the T-BERD DLC Analyzer. These messages also appear in the DATALINK category as a historical record of the indicated

events. If the *SW PROT FAILED* message appears, the selected shelf is already on the protection line or the switch to protection sequence failed.

4. **INSERT switch**
   Press this switch to stop sending the command to the RT. The switch LED goes out.

Verify Maintenance Test Sequence

1. **SOURCE I switch**
   Select the MAINT command to establish the automated maintenance test procedure.

2. **SECONDARY CHANNEL switch**
   Select the desired DS0 channel.

3. **INSERT switch**
   Press this switch to insert and send the MAINT command to the RT. The switch LED illuminates while in the insert mode. The maintenance test is performed on the DS0 channel selected in Step 2.

4. **Datalink results interpretation**
   S MAINT HOOK/SEIZE, S MAINT PROCEED, S MAINT TEST ALARM
   These messages occur when an automated maintenance test is being performed. The messages are displayed long enough to see that the operation is in progress; the actual sequence takes less than two seconds. These messages also appear in the DATALINK category as a historical record of the indicated events.

   NOTE: The T-BERD DLC Analyzer emulates the maintenance test generated from the COT.

Disconnect the T-BERD DLC Analyzer

1. **INSERT switch**
   Press this switch to stop sending the command to the RT. The switch LED goes out.

2. **TRANSMIT jack**
   Disconnect the cable from the DSX-1 jack first. Then disconnect the cable from the T-BERD DLC Analyzer.

   NOTE: You may notice a brief glitch in the T1 signal when the cable is disconnected from the DSX-1 IN jack.

3. **PRIMARY RECEIVE and SECONDARY RECEIVE jacks**
   Disconnect the cables from the DSX-1 MON jacks, then the T-BERD DLC Analyzer.

20. VERIFYING RING GENERATION
T-BERD DLC ANALYZER OPTION REQUIRED

- Verify the ring generator is functioning at the remote terminal (RT).

Figure 30 illustrates the T-BERD DLC Analyzer Option testing the RT ring generator from the DSX-1 access point.

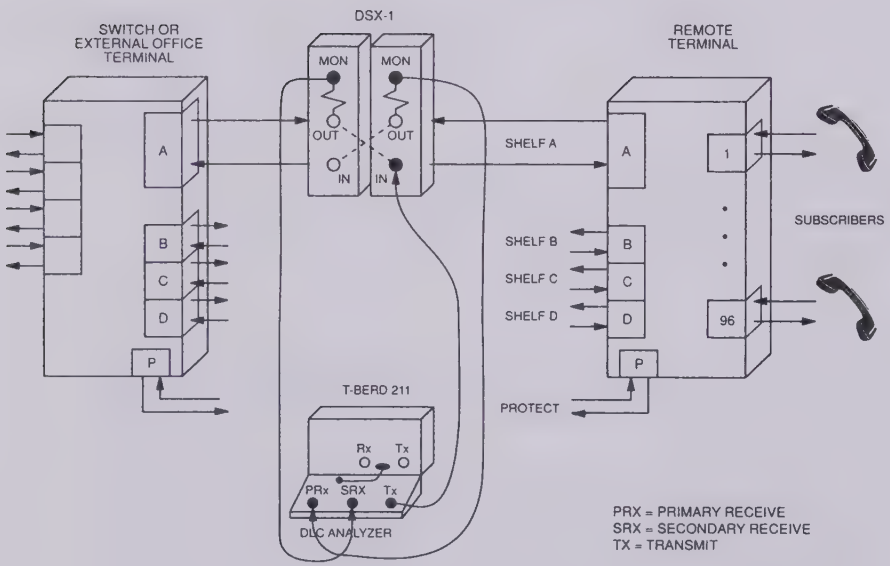


Figure 30
Testing Ring Generators

Connect DLC Analyzer Option To T-BERD 211

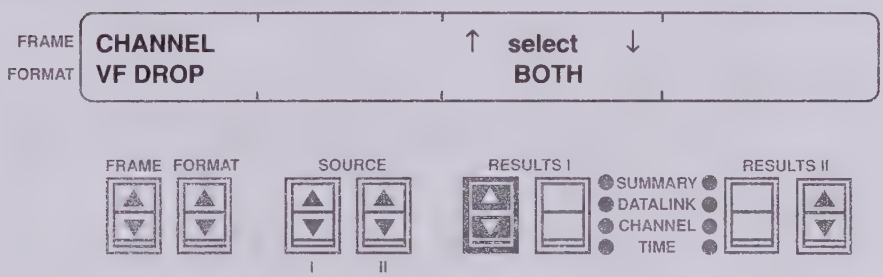
1. **T-BERD 211 — turn power off**

2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to the T-BERD 211 15-pin D connector.

3. **T-BERD 211 — turn power on**

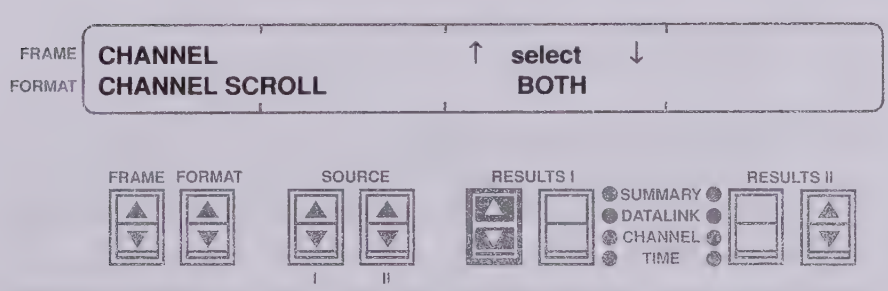
T-BERD DLC Analyzer Option Test Setup

4. **AUX/FRAME/FORMAT switch**
   Select the CHANNEL/VF DROP auxiliary function to set which T1 line the DS0 channel is dropped from.



   Set for PRIMARY to drop the DS0 channel from the PRIMARY RECEIVE T1 signal. Set for SECONDARY to drop the DS0 channel from the SECONDARY RECEIVE T1 signal. Set for BOTH to drop the DS0 channel from BOTH T1 signals.

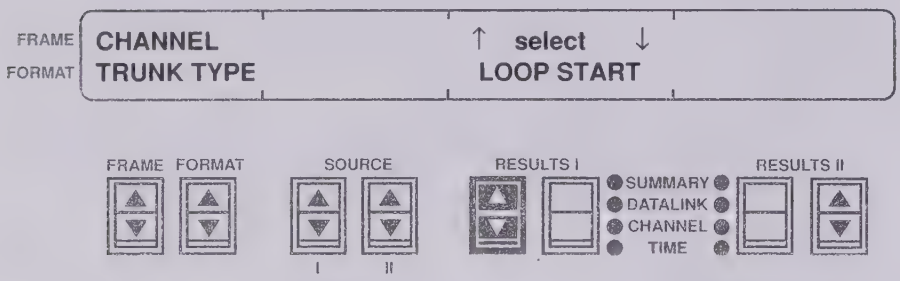
5. **FORMAT switch**
   Select the CHANNEL/CHANNEL SCROLL auxiliary function to set the **PRIMARY** and **SECONDARY CHANNEL** switch control.



Set for BOTH to scroll the **PRIMARY** and **SECONDARY CHANNEL** switch numbers simultaneously. Set for SEPARATE to scroll the switch numbers independently.

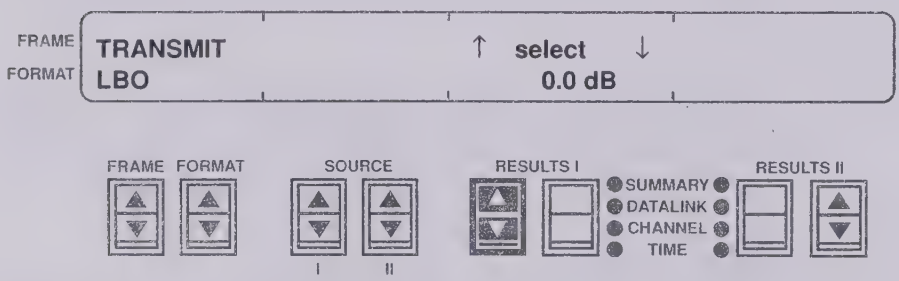
6. **FORMAT switch**

Select the CHANNEL/TRUNK TYPE auxiliary function to set the signaling protocol.



7. **FRAME switch**

Select TRANSMIT/LBO to set the LBO level. If transmitting into the span, set the LBO for 0.0 dB. If transmitting into the equipment, set the LBO for -15.0 dB.



8. **AUX switch**

Exit auxiliary functions.

9. **FRAME switch**

Select SLC-M1 mode.

10. **SECONDARY CHANNEL switch**

Set this switch to the double dashes (— —). This prevents the T-BERD DLC Analyzer from inserting the channel signaling into a channel.

11. **FORMAT switch**
    Select CHANNEL format.

12. **CODE switch**
    Select the appropriate coding.

13. **RECEIVE INPUT switch and PRIMARY RECEIVE jack**
    Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

    - If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.
    - If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

14. **SECONDARY RECEIVE jack**
    Connect a cable between this jack and the T1 line as follows:

    - If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.
    - If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

15. **TRANSMIT jack**
    Connect the cable to the T-BERD DLC Analyzer first, then connect the cable as follows:

    - If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 IN jack.
    - If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 IN jack.

    NOTE: You may notice a brief glitch in the T1 signal when the cable is connected to the DSX-1 IN jack.

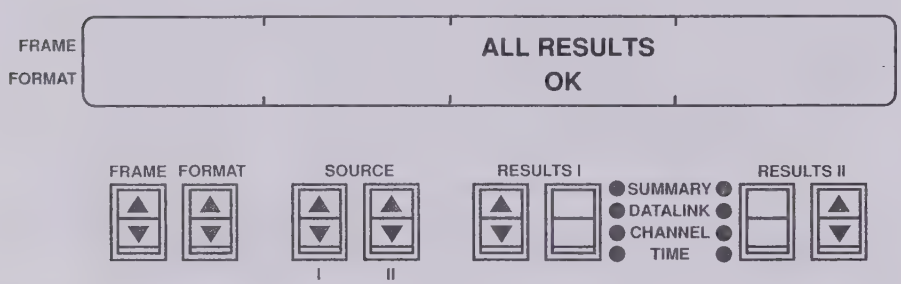
16. **RESTART switch**
    Clear the results and start the test.

17. Status LEDs

Both primary and secondary LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarms LED may illuminate.

18. RESULTS I switches

Check SUMMARY category. If errors or alarms are not detected, *ALL RESULTS OK* appears. If errors or alarms are detected, scroll through the SUMMARY category for specific errors or alarms. Check the other categories as required.



19. ON HOOK switch

Press this switch to place a channel on hook. The switch LED illuminates while active and the **ABCD** switches are updated.

20. SECONDARY CHANNEL switch

Select the desired DS0 channel. When the channel is selected, the T-BERD DLC Analyzer inserts the selected signaling bits.

21. DS0 channel results interpretation

P TRAFFIC CHANNEL AB, P TRAFFIC CHANNEL ABCD, P TRAFFIC TIMESLOT, and P TS CH

For all framing formats except SLC-M2, monitor the channel signaling bits.

22. OFF HOOK switch

Press this switch to place the channel off hook. Note that dial tone can be heard from the speaker. The switch LED illuminates while active and the **ABCD** switches are updated. The **ON HOOK** switch LED goes out and the **ABCD** switches indicate the change.

NOTE: If the dial tone is not heard, verify that the trunk type signaling protocol set by the CHANNEL/TRUNK TYPE auxiliary function matches the circuit protocol. Also check the volume level of the speaker.

23. **RING switch**

Press this switch to ring the local subscriber loop. Note that the ring back signal is heard from the speaker. The switch LED illuminates while active and the **ABCD** switches are updated. The T-BERD DLC Analyzer emulates the central office terminal.

24. **ON HOOK switch**

Press this switch to place the channel on hook. The switch LED illuminates while active and the **ABCD** switches are updated.

Disconnect the T-BERD DLC Analyzer

25. **TRANSMIT jack**

Disconnect the cable from the DSX-1 jack first. Then disconnect the cable from the T-BERD DLC Analyzer.

NOTE: You may notice a brief glitch in the T1 signal when the cable is disconnected from the DSX-1 IN jack.

26. **PRIMARY RECEIVE and SECONDARY RECEIVE jacks**

Disconnect the cables from the DSX-1 MON jacks, then the T-BERD DLC Analyzer.

21. VERIFY CHANNEL UNIT SIGNALING
T-BERD DLC ANALYZER OPTION AND BUTT-SET REQUIRED

- Verify ring generator is functioning at the remote terminal (RT).
- Test one or all 24 channels on a shelf.

Figure 31 illustrates the T-BERD DLC Analyzer Option testing the DTMF dialing capabilities from the DSX-1 access point.

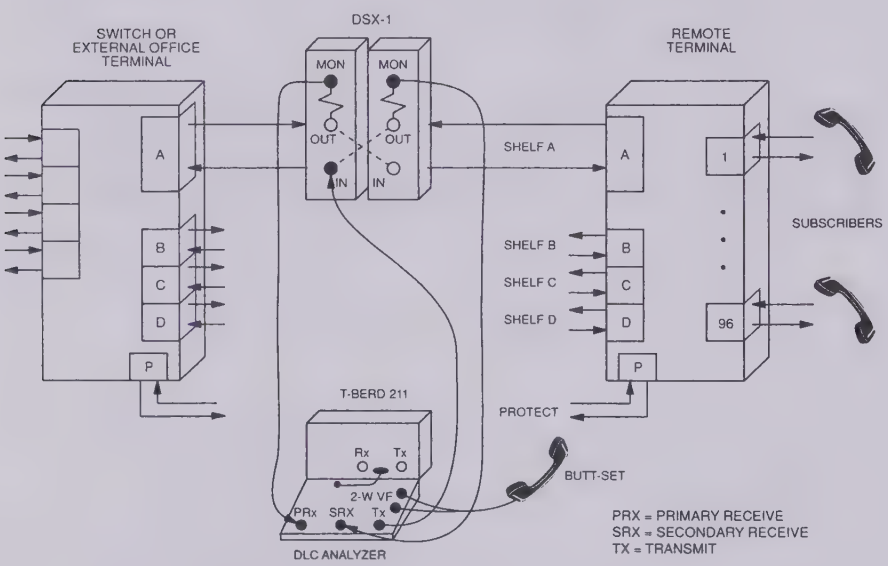


Figure 31
Verify Channel Unit Signaling

Connect DLC Analyzer Option To T-BERD 211

1. **T-BERD 211 — turn power off**

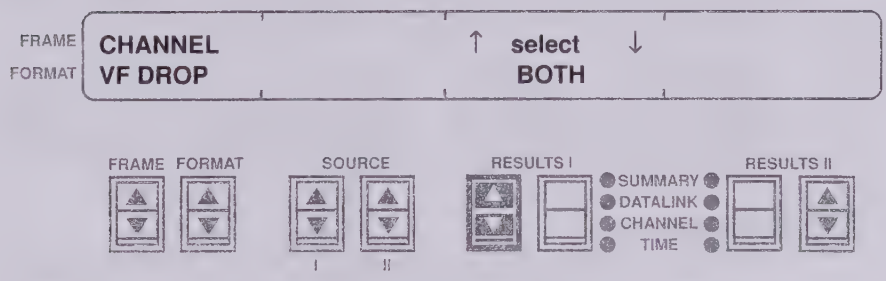
2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to the T-BERD 211 15-pin D connector.

3. **T-BERD 211 — turn power on**

T-BERD DLC Analyzer Option Test Setup

4. **AUX/FRAME/FORMAT switch**

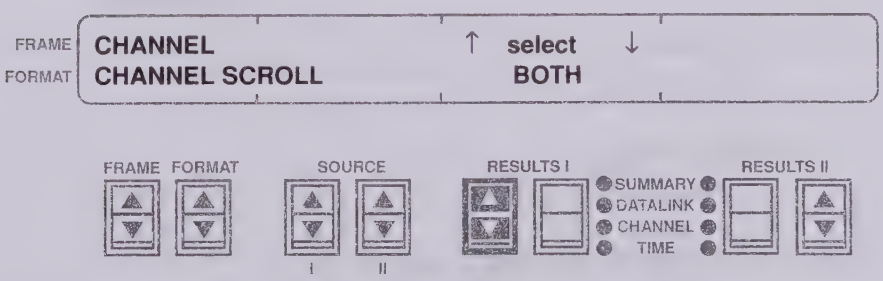
   Select the CHANNEL/VF DROP auxiliary function to set which T1 line the DS0 channel is dropped from.



   Set for PRIMARY to drop the DS0 channel from the PRIMARY RECEIVE T1 signal. Set for SECONDARY to drop the DS0 channel from the SECONDARY RECEIVE T1 signal. Set for BOTH to drop the DS0 channel from BOTH T1 signals.

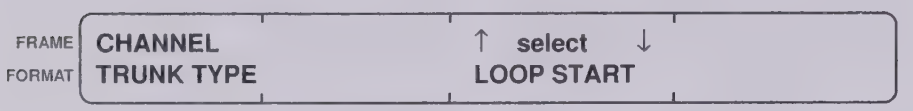
5. **FORMAT switch**

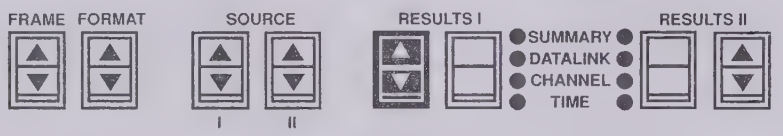
   Select the CHANNEL/CHANNEL SCROLL auxiliary function to set the **PRIMARY** and **SECONDARY CHANNEL** switch control.



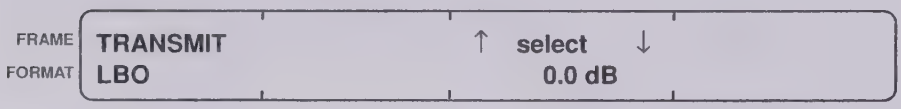
   Set for BOTH to scroll the **PRIMARY** and **SECONDARY CHANNEL** switch numbers simultaneously. Set for SEPARATE to scroll the switch numbers independently.

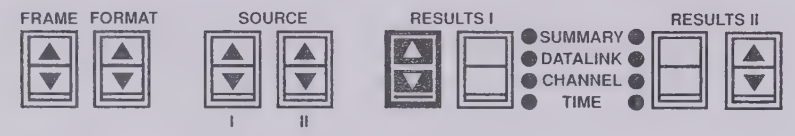
6. **FORMAT switch**
   Select the CHANNEL/TRUNK TYPE auxiliary function to set the signaling protocol.





7. **FRAME switch**
   Select TRANSMIT/LBO to set the LBO level. If transmitting into the span, set the LBO for 0.0 dB. If transmitting into the equipment, set the LBO for -15.0 dB.





8. **AUX switch**
   Exit auxiliary functions.

9. **FRAME switch**
   Select SLC-M1 mode.

10. **SECONDARY CHANNEL switch**
    Set this switch to the double dashes (— —). This prevents the T-BERD DLC Analyzer from inserting the channel signaling into a channel.

11. **FORMAT switch**
    Select CHANNEL format.

12. **CODE switch**
    Select the appropriate coding.

13. **2-Wire VF Interface**
    Connect a butt-set to the 2-wire VF posts on the right side near the RS-232 interface. Leave the butt-set **MON/TALK** switch in the MON or released position.

14. **RECEIVE INPUT switch and PRIMARY RECEIVE jack**
    Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

    - If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.
    - If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

15. **SECONDARY RECEIVE jack**
    Connect a cable between this jack and the T1 line as follows:

    - If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.
    - If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

16. **TRANSMIT jack**
    Connect the cable to the T-BERD DLC Analyzer first, then connect the cable as follows:

    - If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 IN jack.
    - If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 IN jack.

    NOTE: You may notice a brief glitch in the T1 signal when the cable is connected to the DSX-1 IN jack.

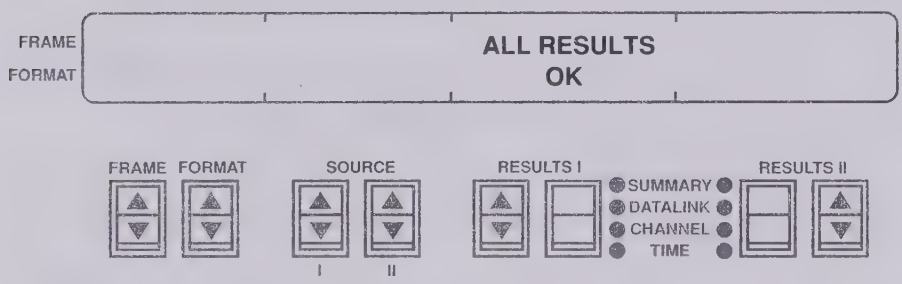
17. **RESTART switch**
    Clear the results and start the test.

18. **Status LEDs**

Both primary and secondary LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarms LED may illuminate.

19. **RESULTS I switches**

Check SUMMARY category. If errors or alarms are not detected, *ALL RESULTS OK* appears. If errors or alarms are detected, scroll through the SUMMARY category for specific errors or alarms. Check the other categories as required.



20. **SOURCE I switch**

Set to VF INTF.

21. **SECONDARY CHANNEL switch**

Select the desired DS0 channel.

22. **INSERT switch**

Press this switch to test from the 2-wire VF interface. The switch LED illuminates while in the insert mode.

23. **VOLUME control**

Adjust the control to monitor the selected DS0 channel through the speaker. Verify that the line is idle.

24. **Butt-set**

Press the **MON/TALK** switch to the TALK position. Verify that dial tone is heard.

Dial the telephone number. Verify that ringing is heard and the telephone is answered.

Press the **MON/TALK** switch to the MON position. Verify that the line is idle and dial tone is not heard.

Disconnect the T-BERD DLC Analyzer

25. **TRANSMIT jack**
    Disconnect the cable from the DSX-1 jack first. Then disconnect the cable from the T-BERD DLC Analyzer.

    NOTE: You may notice a brief glitch in the T1 signal when the cable is disconnected from the DSX-1 IN jack.

26. **PRIMARY RECEIVE and SECONDARY RECEIVE jacks**
    Disconnect the cables from the DSX-1 MON jacks, then the T-BERD DLC Analyzer.

22. IN-SERVICE SHELF BIT ERROR RATE TESTING
T-BERD DLC ANALYZER OPTION REQUIRED

- Verify the alarm, switch to protection, and far-end loop response capabilities of the remote terminal (RT).
- Perform a switch to protection line and test the selected shelf.

Figure 32 illustrates the T-BERD DLC Analyzer Option and T-BERD 211 testing the RT from the CO DSX-1 access point.

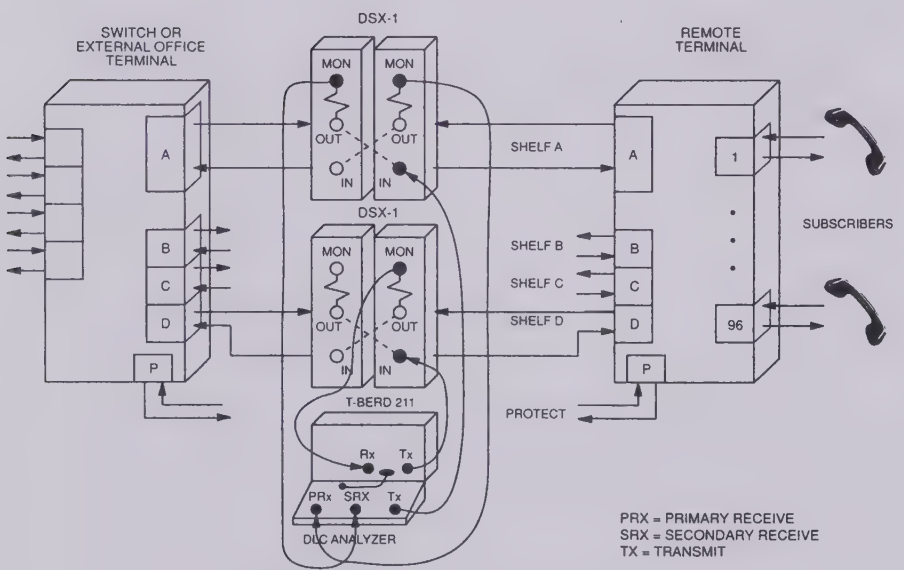


Figure 32
In-Service Shelf Testing

Connect DLC Analyzer Option To T-BERD 211

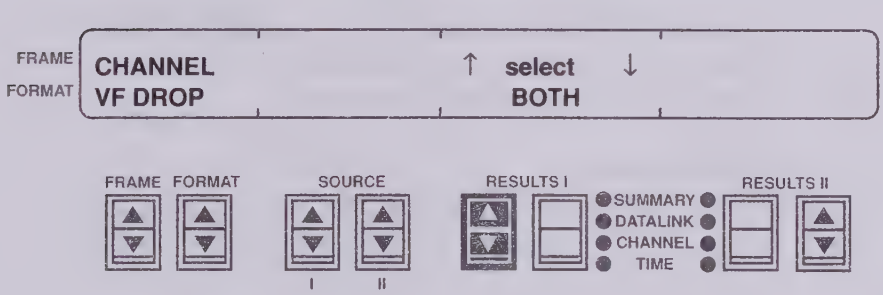
1. **T-BERD 211 — turn power off**

2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to the T-BERD 211 15-pin D connector.

3. **T-BERD 211 — turn power on**

T-BERD DLC Analyzer Option Test Setup

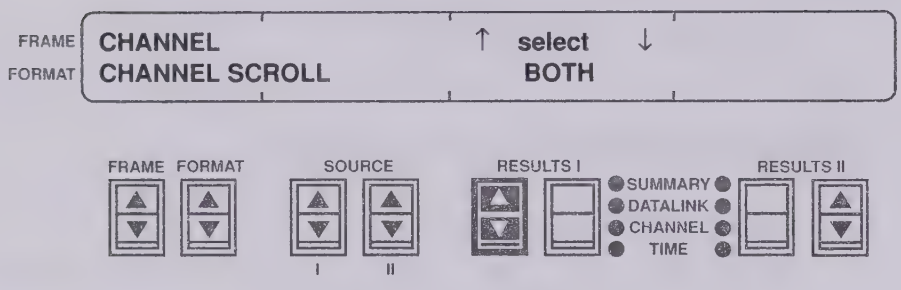
4. **AUX/FRAME/FORMAT switch**
   Select the CHANNEL/VF DROP auxiliary function to set which T1 line the DS0 channel is dropped from.



Set for PRIMARY to drop the DS0 channel from the PRIMARY RECEIVE T1 signal. Set for SECONDARY to drop the DS0 channel from the SECONDARY RECEIVE T1 signal. Set for BOTH to drop the DS0 channel from BOTH T1 signals.

5. **FORMAT switch**

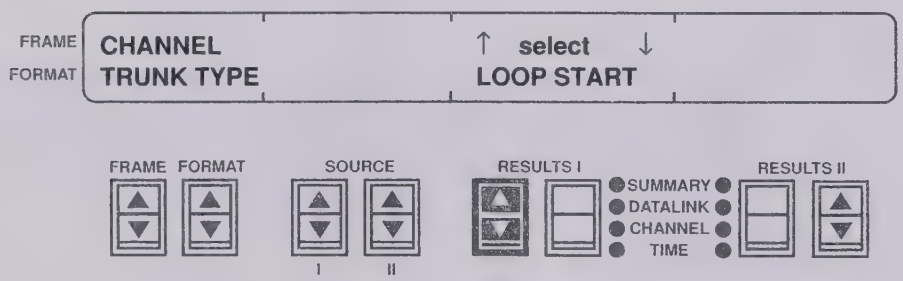
Select the CHANNEL/CHANNEL SCROLL auxiliary function to set the **PRIMARY** and **SECONDARY CHANNEL** switch control.



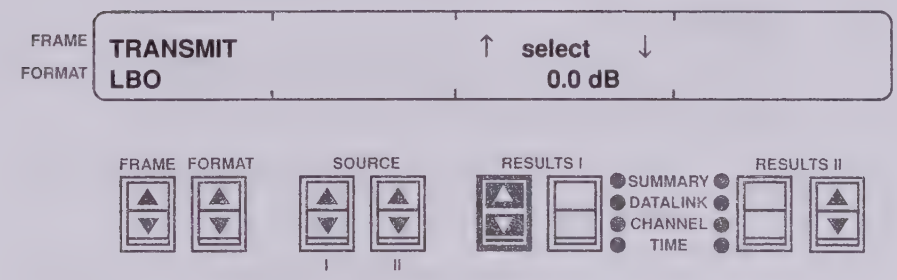
Set for BOTH to scroll the **PRIMARY** and **SECONDARY CHANNEL** switch numbers simultaneously. Set for SEPARATE to scroll the switch numbers independently.

6. **FORMAT switch**

Select the CHANNEL/TRUNK TYPE auxiliary function to set the signaling protocol.



7. **FRAME switch**
   Select TRANSMIT/LBO to set the LBO level. If transmitting into the span, set the LBO for 0.0 dB. If transmitting into the equipment, set the LBO for -15.0 dB.



8. **AUX switch**
   Exit auxiliary functions.

9. **FRAME switch**
   Select SLC-M1 mode.

10. **FORMAT switch**
    Select DATLINK format.

11. **CODE switch**
    Select the appropriate coding.

12. **RECEIVE INPUT switch and PRIMARY RECEIVE jack**
    Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

    - If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.
    - If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

13. **SECONDARY RECEIVE jack**
    Connect a cable between this jack and the T1 line as follows:

    - If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

- If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

14. TRANSMIT jack

Connect the cable to the T-BERD DLC Analyzer first, then connect the cable as follows:

- If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 IN jack.

- If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 IN jack.

NOTE: You may notice a brief glitch in the T1 signal when the cable is connected to the DSX-1 IN jack.

15. RESTART switch

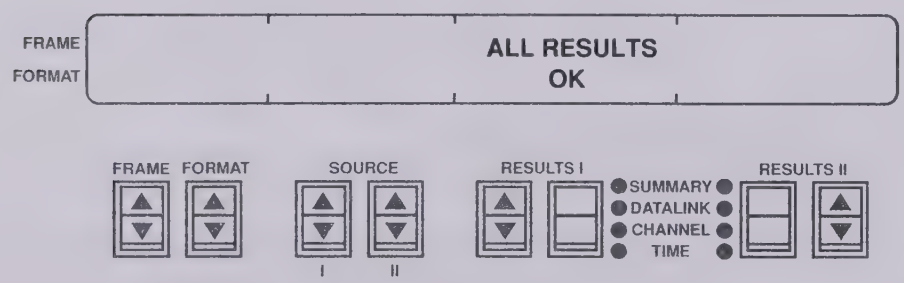
Clear the results and start the test.

16. Status LEDs

Both primary and secondary LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarms LED may illuminate.

17. RESULTS I switches

Check SUMMARY category. If errors or alarms are not detected, *ALL RESULTS OK* appears. If errors or alarms are detected, scroll through the SUMMARY category for specific errors or alarms. Check the other categories as required.



18. SOURCE I and II switches

Select **SOURCE I** for FE LOOP and **SOURCE II** for SHELF D.

19. **INSERT switch**
    Press this switch to insert and send the far-end loop command to the RT. The switch LED illuminates while in the insert mode. The Shelf D is automatically switched to the protection line and the Shelf D T1 line is looped back.

20. **Datalink results interpretation**
    P SHELF D ON PROT and P FE LOOP SHELF D
    These alarms indicate that Shelf D is switched to the protection line and looped back to the CO.

T-BERD 211 Mainframe Test Setup

1. **MODE switch**
   Select the T1 D4 or appropriate mode.

2. **PATTERN switch**
   Select the appropriate test pattern.

3. **TIMING switch**
   Set to INT.

4. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

   - If at the CO, connect a cable between this jack and the Shelf D span-side DSX-1 MON jack.
   - If at the RT, connect a cable between this jack and the Shelf D equipment-side DSX-1 MON jack.

5. **TRANSMIT OUTPUT switch and jack**
   Select the appropriate output level, and connect a cable between this jack and the T1 line as follows:

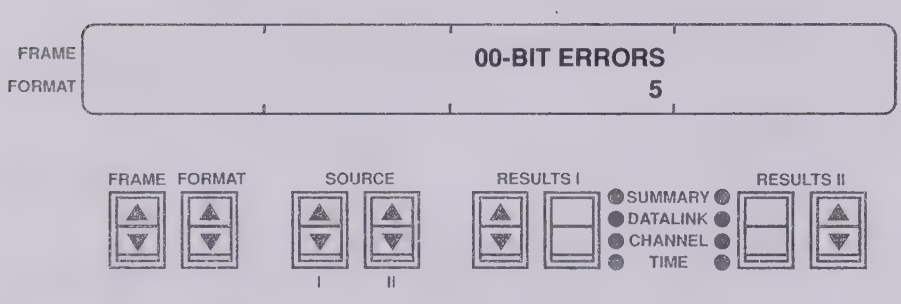
   - If at the CO, set the output level to 0dB(DSX) and connect a cable between this jack and the Shelf D span-side DSX-1 IN jack.

- If at the RT, set the output level to -15dB and connect a cable between this jack and the Shelf D equipment-side DSX-1 IN jack.

6. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

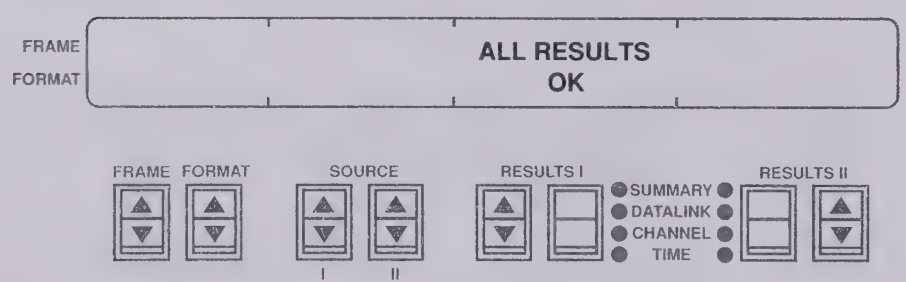
7. **RESULTS I Category switch**
   Select the SUMMARY category.

8. **LOGIC ERROR INSERT switch**
   Press the switch five times to verify that the logic errors are received and the T1 circuit is looped back.



9. **RESTART switch**
   Clear the results and start the test.

10. **RESULTS I switches**
    Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



11. **Results interpretation**

00-BIT ERRORS, 25-VIOLATIONS, and 30-FRM ERRORS

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be +4 to -4 dBdsx at the terminated DSX-1 OUT jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end.

Disconnect the Test Sets

1. **T-BERD 211 — Disconnect the cables**

When the test is complete, disconnect the cables from the Shelf D DSX-1 jacks.

2. **T-BERD DLC Analyzer — INSERT switch**

Press this switch to release Shelf D from the far-end loopback and protection line.

3. **TRANSMIT jack**

   Disconnect the cable from the DSX-1 jack first. Then disconnect the cable from the T-BERD DLC Analyzer.

   NOTE: You may notice a brief glitch in the T1 signal when the cable is disconnected from the DSX-1 IN jack.

4. **PRIMARY RECEIVE and SECONDARY RECEIVE jacks**

   Disconnect the cables from the DSX-1 MON jacks, then the T-BERD DLC Analyzer.

23. CHECKING SLC MODE II TIMESLOT MAPPING
T-BERD DLC ANALYZER OPTION REQUIRED

- Verify the Mode II timeslot channel mapping.

Figure 33 illustrates the T-BERD DLC Analyzer Option testing the Mode II RT from the CO DSX-1 access point.

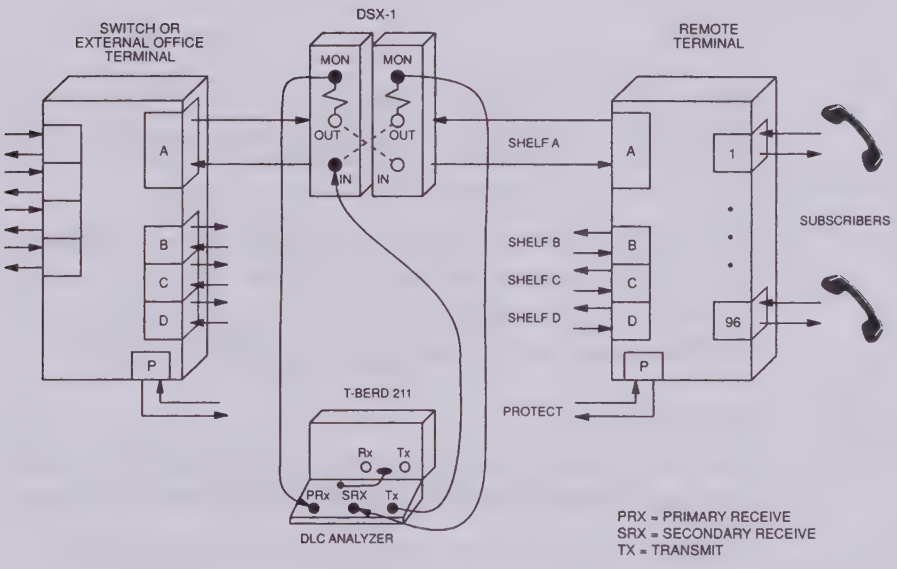


Figure 33
Checking SLC Mode II Timeslot Mapping

Connect DLC Analyzer Option To T-BERD 211

1. **T-BERD 211 — turn power off**

2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to the T-BERD 211 15-pin D connector.

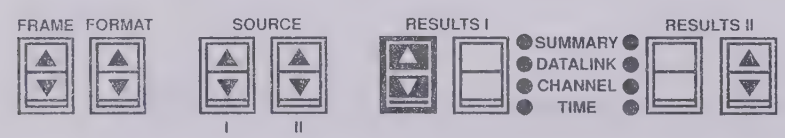
3. **T-BERD 211 — turn power on**

T-BERD DLC Analyzer Option Test Setup

4. **AUX/FRAME/FORMAT switch**
   Select the CHANNEL/VF DROP auxiliary function to set which T1 line the DS0 channel is dropped from.

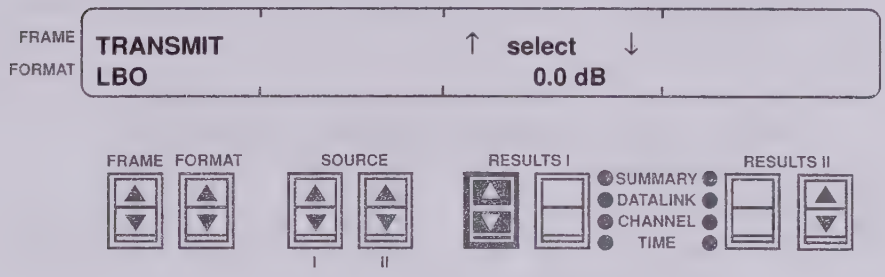
   Set for PRIMARY to drop the DS0 channel from the PRIMARY RECEIVE T1 signal. Set for SECONDARY to drop the DS0 channel from the SECONDARY RECEIVE T1 signal. Set for BOTH to drop the DS0 channel from BOTH T1 signals.

5. **FORMAT switch**
   Select the CHANNEL/CHANNEL SCROLL auxiliary function to set the **PRIMARY** and **SECONDARY CHANNEL** switch control.



   Set for BOTH to scroll the **PRIMARY** and **SECONDARY CHANNEL** switch numbers simultaneously. Set for SEPARATE to scroll the switch numbers independently.

6. **FRAME switch**
   Select TRANSMIT/LBO to set the LBO level. If transmitting into the span, set the LBO for 0.0 dB. If transmitting into the equipment, set the LBO for -15.0 dB.



7. **AUX switch**
   Exit auxiliary functions.

8. **FRAME switch**
   Select SLC-M2 mode.

9. **SECONDARY CHANNEL switch**
   Set this switch to the double dashes (— —). This prevents the T-BERD DLC Analyzer from inserting the channel signaling into a channel.

10. **FORMAT switch**
    Select DATLINK format.

11. **CODE switch**
    Select the appropriate coding.

12. **RECEIVE INPUT switch and PRIMARY RECEIVE jack**
    Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

    - If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.
    - If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

13. **SECONDARY RECEIVE jack**
    Connect a cable between this jack and the T1 line as follows:

    - If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

- If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

14. **TRANSMIT jack**
    Connect the cable to the T-BERD DLC Analyzer first, then connect the cable as follows:

    - If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 IN jack.

    - If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 IN jack.

    NOTE: You may notice a brief glitch in the T1 signal when the cable is connected to the DSX-1 IN jack.

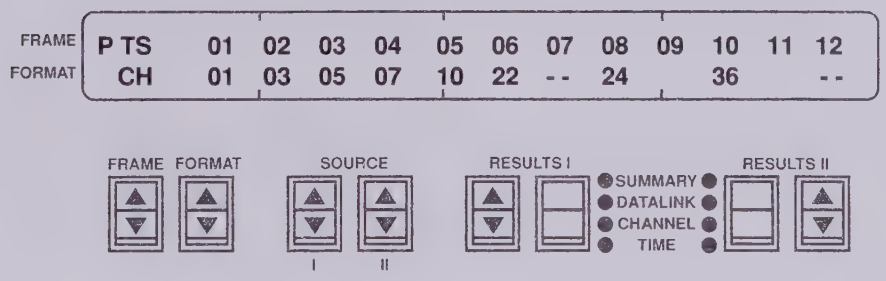
15. **RESTART switch**
    Clear the results and start the test.

16. **Status LEDs**
    Both primary and secondary LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarms LED may illuminate.

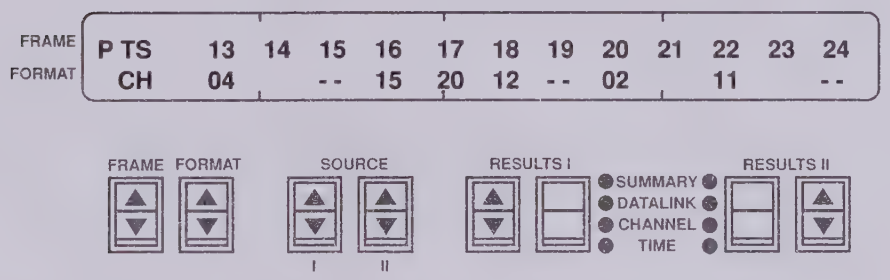
17. **SOURCE I switch**
    Set **SOURCE I** to MAPPINGS.

18. **INSERT switch**
    Press this switch to insert and send the timeslot mapping request to the CO. The switch LED illuminates while in the insert mode. When the request is received, the CO sends a complete timeslot channel assignment report back to the T-BERD DLC Analyzer.

19. **RESULTS I switches**
    Select the CHANNEL category P/S TS CH result. Determine which timeslot or channel you want to monitor. The timeslots are indicated across the top line. The active timeslots have the mapped channel number below it. The "— —" is unassigned timeslot and a blank timeslot is unknown.

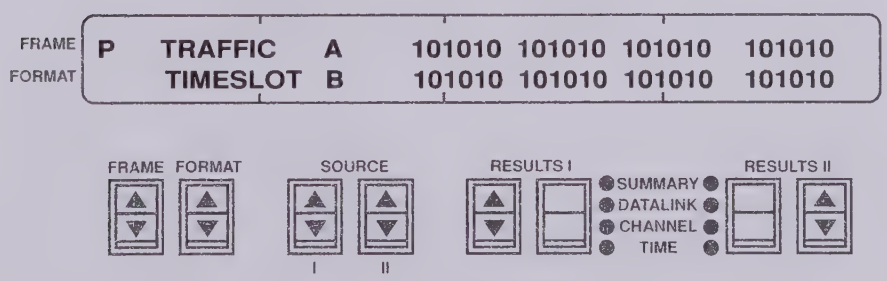


Press the **RESULTS I Results** switch to scroll to timeslots 13 to 24.



20. **PRIMARY CHANNEL or SECONDARY CHANNEL switch**
Select the timeslot you want to monitor by displaying the *timeslot* number in the channel display.

21. **RESULTS I Results switch**
Select the CHANNEL category P/S TRAFFIC TIMESLOT AB result to monitor the timeslot signaling bits.



22. **SLC-M2 channel results interpretation**
P/S TS CH
The top row of numbers indicate the available timeslots. The bottom row of numbers identify the assigned channel of an active timeslot. An unassigned timeslot is indicated by two dashes

(——). An unknown timeslot assignment is left blank. The result is automatically updated as channels assignments and traffic change. Press the **RESULTS I Results** switch to display either the PRIMARY (P) or SECONDARY (S) timeslot channel assignments.

P/S TRAFFIC TIMESLOT AB

This result displays the A and B signaling bits in all 24 timeslots from a single receiver input. Press the **RESULTS I Results** switch to display either the PRIMARY (P) or SECONDARY (S) signaling traffic.

NOTE: The **ABCD** switches are functional in all frame modes. However, the **ON HOOK**, **OFF HOOK**, and **RING** switches are not functional in the SLC-M2 mode.

Disconnect the T-BERD DLC Analyzer

23. **TRANSMIT jack**

Disconnect the cable from the DSX-1 jack first. Then disconnect the cable from the T-BERD DLC Analyzer.

NOTE: You may notice a brief glitch in the T1 signal when the cable is disconnected from the DSX-1 IN jack.

24. **PRIMARY RECEIVE and SECONDARY RECEIVE jacks**

Disconnect the cables from the DSX-1 MON jacks, then the T-BERD DLC Analyzer.

AUXILIARY FUNCTIONS

7-SEGD 211 MAINFRAME

SEND D.C. ANALYZER OPTION

24. MAINFRAME — AUXILIARY FUNCTIONS

The mainframe auxiliary functions are selected using the **MODE** switch. Press the **MODE** switch once from an operating mode (e.g., T1 D4), to select the AUX mode. When the AUX mode appears, the auxiliary functions are selected by pressing the **PATTERN** switch.

Table 4 lists the auxiliary functions by mainframe and option. The auxiliary functions are described in factory-default order.

Table 4
T-BERD 211 Auxiliary Functions

Auxiliary Function	Description
Mainframe	
AUX USER1	User 1 Programmable Test Pattern
AUX USER2	User 2 Programmable Test Pattern
AUX RESPONSE	Loop Code Response Function
AUX PGM LPUP	Programmable Loop-up Code
AUX PGM LPDN	Programmable Loop-down Code
AUX BAUD	RS-232 Printer/Remote Control Baud Rate Select
AUX PARITY	RS-232 Printer/Remote Control Parity Select
AUX HALT/CONT	Action on Pattern Synchronization Loss
AUX PRNT FMT	Results Printout Format
AUX TERM	RS-232 Printer/Remote Control Line Terminator
AUX PLS MASK	Pulse Shape Measurement Mask Select
AUX RES HIST	Results History Buffer
AUX HIST CLR	Clear History and Printer Buffers
AUX ERR SEL	BPV and Logic Error Burst Duration Select
AUX FRM ERR	Frame Error Insertion Select
AUX ER RATE	BPV and Logic Error Insertion Rate
AUX CLOCK	Set Clock Time
AUX DATE	Set Date
AUX TEST LEN	Set Timed Test Length Duration

Table 4
T-BERD 211 Auxiliary Functions (Continued)

Auxiliary Function	Description
AUX GRAPH AUX LP CODE AUX ESF LOOP	Print Graph Function Loop Code Select ESF Loop Code Select
Jitter Spectral Analysis Option	
AUX JIT S/A AUX JIT MASK AUX JIT TRIG	Jitter Spectral Analysis Control Spectral Analysis Jitter Mask Select Spectral Analysis Jitter Trigger Select
Advanced BERT Option	
AUX LUP	Programmable Long User Pattern
Fractional T1 Option	
AUX FT1 CHAN AUX FT1 SETUP	Fractional T1 Channel Bandwidth FT1 Idle Code and Channel Rate
Enhanced ESF Option	
AUX PRM	Performance Report Message Control

25. T-BERD DLC ANALYZER OPTION — AUXILIARY FUNCTIONS

The T-BERD DLC Analyzer Option auxiliary functions are selected with the **AUX** switch.

Press the **FRAME** switch to scroll through the three auxiliary groups: CHANNEL, TRANSMIT, and TIME. The auxiliary group name appears in the FRAME window.

Press the **FORMAT** switch to scroll through the auxiliary functions within a selected auxiliary group. The auxiliary function name appears in the FORMAT window.

Press the **RESULTS I Results** or **RESULTS II Results** switch to select or modify the auxiliary function.

The T-BERD DLC Analyzer provides the following auxiliary functions listed in Table 5.

Table 5
T-BERD DLC Analyzer Option Auxiliary Functions

Auxiliary Function	Description
CHANNEL/VF DROP	T1 Channel VF Drop
CHANNEL/TRUNK TYPE	T1 Channel Trunk Type
CHANNEL/CHANNEL SCROLL	T1 Channel Scrolling
TRANSMIT/LBO	T1 Transmitter Line Build-Out
TIME/SET TIME	Set Time of Day
TIME/SET DATE	Set Date

26. MAINFRAME — SIGNAL ALARMS

Signal Loss — 150 ms without input pulses after valid frequency and level are detected.

Pattern Sync Loss — 250 errors detected in 1000 or fewer bits.

Frame Sync Loss — On T1 D4 and T1 SLC framing, 2 out of 5 F_t bits in error causes frame synchronization loss. On T1 ESF and T1 ESFz framing, 2 out of 5 frame bits in error causes frame synchronization loss.

Excess Zeros — In T1 signals, excess zeros occur in AMI coding with 16 consecutive zeros and B8ZS encoding with 8 consecutive zeros. In T1C signals, excess zeros occur with 34 consecutive zeros.

Yellow Alarm — In T1 D4 and T1 SLC framing, a Yellow Alarm occurs when Bit 2 is a 0 for 255 consecutive channels. In T1 ESF framing, a Yellow Alarm occurs when 256 bits, ±16 bits, of a repetitive 1111 1111 0000 0000 ... pattern is received in the 4 kb/s datalink.

All Ones — In unframed T1 or T1C signals, 2048 consecutive ones constitutes an All Ones condition. In framed T1 signals, 256 consecutive DS0 channels with all ones constitutes an All Ones condition.

Ones Density — Less than n ones in 8(n+1) bits, where n = 1 to 23 per AT&T PUB62411 and ANSI T1.403. The LED is disabled when receiving a T1-QRSS pattern or any T1C signal.

Pulse Shape — Received pulse shape exceeds selected pulse shape mask specification.

Jitter — Without the Jitter Spectral Analysis Option installed, the wideband jitter exceeds 5 UI or the highband jitter exceeds 0.1 UI warrants excess jitter. With the Jitter Spectral Analysis Option installed and turned off, the wideband jitter exceeds 5 UI or highband jitter exceeds 0.1 UI warrants excess jitter. With the Jitter Spectral Analysis Option installed and turned on, the measured jitter exceeds 100% of the selected jitter mask.

27. MAINFRAME — TEST RESULTS

The categories are selected with the **RESULTS I** and **II Category** switches. Pressing the switch illuminates the category LED and displays the previously displayed category result. The category results are displayed by pressing the **RESULTS I** and **II Results** switches.

The six categories and the available results are listed as follows.

SUMMARY Category

Mainframe	Enhanced ESF Option
00-BIT ERRORS	17-FAR FRM ES
09-SLIPS	18-FAR FRM SES
25-VIOLATIONS	19-FAR BPV SEC
30-FRM ERRORS	20-FAR SLP SEC
32-CRC ERRORS	22-FAR CRC ERR
34-FRM LOS CNT	
40-RX FREQ Hz	
44-PULSE SHAPE	
51-TIMING SLIP	

LOGIC Category

Mainframe	G.821 Performance Analysis Option
00-BIT ERRORS	10-SEV ERR SEC
01-ASYN ER SEC	11-%SEV ER SEC
04-BIT ERR RT	12-DEGR MIN
05-ER FREE SEC	13-%DEGR MIN
06-%EFS	14-UNAVL SEC
07-SYN ERR SEC	15-%AVLBILITY
08-OUT SYN SEC	16-CSES
09-SLIPS	

BPV & FRAME Category

Enhanced ESF Option	Mainframe
17-FAR FRM ES	25-VIOLATIONS
18-FAR FRM SES	26-BPV SECONDS
19-FAR BPV SEC	27-BPV RATE
20-FAR SLP SEC	28-FRM ERR SEC
21-FAR PRM SEC	29-FRM SES
22-FAR CRC ERR	30-FRM ERRORS
22-FCRC 1	31-FRM ER RATE
22-FCRC 2-5	32-CRC ERRORS
22-FCRC 6-10	33-CRC ERR SEC
22-FCRC11-100	34-FRM LOS CNT
22-FCRC101-319	35-FRM LOS SEC
22-FCRC>319	36-CRC SES
23-PAY SRC	37-CRC ERR RT

SIGNAL Category

	Mainframe
40-RX FREQ, Hz	47-FALL TIME
41-RX LEVEL (dBdsx)	48-UNDERSHOOT
42-RX LEVEL (dBm)	49-OVERSHOOT
43-RX LEVEL (Vp-p)	50-SPX CURRENT
44-PULSE SHAPE	51-TIMING SLIP
45-PULSE WIDTH	53-SLP ANA SEC
46-RISE TIME	

TIME Category

	Mainframe
60-SIG LOS SEC	64-TEST END IN
61-ALARMED SEC	65-CLOCK TIME
62-TEST LENGTH	66-DATE
63-ELAPSE TIME	

JITTER & WANDER Category

Mainframe

70-WANDER +PK
71-WANDER -PK
72-P-P WANDER
73-15m WANDER
74-24h WANDER
75-TIE WANDER

80-WB/HB JIT
81-WB JITTER
82-HB JITTER
84-MAX WB JIT
85-MAX HB JIT

Jitter Spectral Analysis Option

88-SA P/F
89-SA FREQ (auto scan)
90-SA FREQ (man. scan)

28. MAINFRAME — SUMMARY CATEGORY

The following SUMMARY category displays key non-zero, out-of-specification, or PRM test results without having to scroll through all the categories to find them.

00-BIT ERRORS

Bit Errors — A count of received bits which have a value opposite that of the corresponding transmitted bits (Mark or Space) after pattern synchronization is achieved.

09-SLIPS

Pattern Slips — A count of the total number of pattern slips since the beginning of the test.

17-FAR FRM ES

Far-End Frame Error Seconds — A count of the seconds in which one or more frame errors occurred in the received signal at the far end. This result reports on the PRM Frame-Synchronization-Bit Error Event Bit (FE = 1) status.

18-FAR FRM SES

Far-End Severely Errored Framing Seconds — A count of the seconds in which two or more frame errors occurred in less than 3 ms in the received signal at the far end. This result reports on the PRM Severely-Errored Framing Event Bit (SE = 1) status.

19-FAR BPV SEC

Far-End BPV Seconds — A count of the seconds in which one or more BPVs occurred in the received signal at the far end. This result reports on the PRM Line-Code Violation Event Bit (LV = 1) status.

20-FAR SLP SEC

Far-End Controlled Slip Seconds — A count of the seconds in which controlled slips occurred in the received signal at the far end. This result reports on the PRM Controlled-Slip Event Bit (SL = 1) status.

22-FAR CRC ERR

Far-End CRC Error Events — A count of the minimum number of CRC errors reported in the following 22-FCRC results. A ">" (greater than) preceding the count indicates that the Bins 2 through 6 are non-zero. This result reports on the PRM CRC Error Event Bits (G1 to G6) status.

25-VIOLATIONS

Bipolar Violation Count — A count of BPVs detected since the start of the test (excluding intentional violations found within B8ZS codes).

30-FRM ERRORS

Frame Errors — A count of the frame errors detected since the start of the test. For D4-compatible framing, frame errors are counted if either an Ft or an Fs frame bit is in error. For ESF framing, frame errors are counted on FPS bits. In T1 SLC mode, frame errors are counted only if an error is found on an Ft bit.

32-CRC ERRORS

CRC Errors — A count of CRC errors detected. CRC errors are counted only when ESF framing is present in the received T1 data.

34-FRM LOS CNT

Frame Loss Count — A count of discrete losses of frame synchronization that occurred during the test.

40-RX FREQ, Hz

Receive Frequency in Hz — The frequency of the clock recovered from the received data.

44-PULSE SHAPE

Pulse Shape — A PASS/FAIL result which shows whether the T1 pulse shape is within the boundary of the specified pulse mask.

51-TIMING SLIP

Controlled Timing Slips — Timing slips are counted when the RECEIVER input has slipped ±193 bit time periods from the T1 REF input. Single bit slips are displayed graphically next to timing slips.

In addition to the test results, the following status messages appear in the SUMMARY category as required.

ALL RESULTS OK — When all summary results are error-free or meet specification boundaries (e.g., RX FREQ Hz and PULSE SHAPE), this message appears in the display.

ALL RESULTS UNAVAILABLE — Displayed at test restart when the instrument has not synchronized with the received signal.

SIGNAL LOSS — The received signal has been lost. The receiver status LEDs are not illuminated, and the Alarm status LEDs are illuminated.

FAILED PATTERN — Indicates the failed test patterns when performing a BRIDGTAP or MULTIPAT test. The failed pattern is also indicated.

B8ZS DETECTED — Indicates the presence of B8ZS coding in the received signal when the **CODE** switch is set to the AMI position.

NOT B8ZS COMPATIBLE — Indicates the received signal is not B8ZS compatible when transmitting B8ZS encoded ALL ZEROS.

29. MAINFRAME — LOGIC CATEGORY

00-BIT ERRORS

Bit Errors — A count of received bits which have a value opposite that of the corresponding transmitted bits (Mark or Space) after pattern synchronization is achieved.

01-ASYNC ERR SEC

Asynchronous Error Seconds — A count of test seconds where one or more bit errors occurred.

04-BIT ERR RT

Bit Error Rate — The ratio of bit errors to received pattern data bits.

05-ER FREE SEC

Error-Free Seconds — A count of the seconds during which pattern synchronization is maintained through the entire second and no bit error occurred.

06-% EFS

% Error-Free Seconds — The ratio, expressed as a percentage, of error-free seconds to the total number of seconds during which pattern synchronization is present.

07-SYN ERR SEC

Synchronized Error Seconds — A count of errored seconds synchronized to the occurrence of an error (the count and time interval begin with the occurrence of an error).

08-OUT SYN SEC

Out-of-Synchronization Seconds — A count of the total number of seconds, since the beginning of the test, during which pattern synchronization was not maintained for the entire second.

09-SLIPS

Pattern Slips — A count of the total number of pattern slips since the beginning of the test.

10-SEV ERR SEC

Severely Errored Seconds — A count of seconds during which the bit error ratio was worse than 10^{-3} within the available time.

11-%SEV ER SEC

% Severely Errored Seconds — The ratio, expressed as a percentage, of severely errored seconds to the number of available seconds.

12-DEGR MIN

Degraded Minutes — A count of minutes during which the bit error ratio was worse than 10^{-6}.

13-%DEGR MIN

% Degraded Minutes — The ratio, expressed as a percentage, of degraded minutes to the number of available minutes.

14-UNAVL SEC

Unavailable Seconds — A count of unavailable time.

15-%AVLBILITY

% Availability — The ratio, expressed as a percentage, of available seconds to the number of test seconds.

16-CSES

Consecutive Severely Errored Seconds — A count of the number of groups of three or more contiguous severely errored seconds in which an error rate worse than 10^{-3} was found in each second.

30. MAINFRAME — BPV & FRAME CATEGORY

17-FAR FRM ES

Far-End Frame Error Seconds — A count of the seconds in which one or more frame errors occurred in the received signal at the far end. This result reports on the PRM Frame-Synchronization-Bit Error Event Bit (FE = 1) status.

18-FAR FRM SES

Far-End Severely Errored Framing Seconds — A count of the seconds in which two or more frame errors occurred in less than 3 ms in the received signal at the far end. This result reports on the PRM Severely-Errored Framing Event Bit (SE = 1) status.

19-FAR BPV SEC

Far-End BPV Seconds — A count of the seconds in which one or more BPVs occurred in the received signal at the far end. This result reports on the PRM Line-Code Violation Event Bit (LV = 1) status.

20-FAR SLP SEC

Far-End Controlled Slip Seconds — A count of the seconds in which controlled slips occurred in the received signal at the far end. This result reports on the PRM Controlled-Slip Event Bit (SL = 1) status.

21-FAR PRM SEC

Far-End Performance Report Seconds — A count of the total number of seconds, since test restart, in which a valid PRM was received.

22-FAR CRC ERR

Far-End CRC Error Events — A count of the minimum number of CRC errors reported in the following 22-FCRC results. A ">" (greater than) preceding the count indicates that the Bins 2 through 6 are non-zero. This result reports on the PRM CRC Error Event Bits (G1 to G6) status. When the result is displayed and the indicated count is an approximation of the actual CRC error count, a ">" (greater than) sign precedes the result count.

22-FCRC 1

Far-End CRC 1 Bin — A count of the seconds with only one CRC error reported in the received signal at the far end. This result reports on the first PRM CRC Error Event Bit (G1 = 1).

22-FCRC 2-5

Far-End CRC 2 to 5 Bin — A count of the seconds with 2 to 5 CRC errors reported in the received signal at the far end. This result reports on the second PRM CRC Error Event Bit (G2 = 1).

22-FCRC 6-10

Far-End CRC 6 to 10 Bin — A count of the seconds with 6 to 10 CRC errors reported in the received signal at the far end. This result reports on the third PRM CRC Error Event Bit (G3 = 1).

22-FCRC11-100

Far-End CRC 11 to 100 Bin — A count of the seconds with 10 to 100 CRC errors reported in the received signal at the far end. This result reports on the fourth PRM CRC Error Event Bit (G4 = 1).

22-FCRC101-319

Far-End CRC 101 to 319 Bin — A count of the seconds with 101 to 319 CRC errors reported in the received signal at the far end. This result reports on the fifth PRM CRC Error Event Bit (G5 = 1).

22-FCRC>319

Far-End CRC 320 to 333 Bin — A count of the seconds with 320 to 333 CRC errors reported in the received signal at the far end. This result reports on the sixth PRM CRC Error Event Bit (G6 = 1).

23-PAY SRC

Far-End Payload Source/Loopback — Identifies the direction of the PRM according to the PRM Command/Response Bit (C/R) and the Payload Loopback Activated Bit (LB). In end-to-end applications, a customer generated PRM is indicated as CUST (C/R = 0 and LB = 0) and a carrier generated PRM is indicated as CARR (C/R = 1 and LB = 0) in the display. In payload loopback applications, the customer generated PRM is indicated as CUST

LOOP (C/R = 0 and LB = 1) when the customer is looped back and the carrier generated PRM is indicated as CARR LOOP (C/R = 1 and LB = 1) when the carrier is looped back.

25-VIOLATIONS

Bipolar Violation Count — A count of BPVs detected since the start of the test (excluding intentional violations found within B8ZS codes).

26-BPV SECONDS

BPV Seconds — A count of the seconds within which one or more BPVs occurred.

27-BPV RATE

BPV Rate — The ratio of BPVs to the number of data bits received.

28-FRM ERR SEC

Frame Errored Seconds — A count of the seconds during which one or more frame errors occurred.

29-FRAME SES

Severely Errored Frame Seconds — A count of the seconds during which the total number of frame errors equalled 12 or more (D4 framing only).

30-FRM ERRORS

Frame Errors — A count of the frame errors detected since the start of the test. For D4-compatible framing, frame errors are counted if either an Ft or an Fs frame bit is in error. For ESF framing, frame errors are counted on FPS bits. In T1 SLC mode, frame errors are counted only if an error is found on an Ft bit.

31-FRM ER RATE

Frame Error Rate — The ratio of frame errors to the number of analyzed framing bits.

32-CRC ERRORS

CRC Errors — A count of CRC errors detected. CRC errors are counted only when ESF framing is present in the received T1 data.

33-CRC ERRSEC

CRC Errored Seconds — A count of seconds within which one or more CRC errors are detected.

34-FRM LOS CNT

Frame Loss Count — A count of discrete losses of frame synchronization that occurred during the test.

35-FRM LOS SEC

Frame Loss Seconds — A count of seconds since initial frame synchronization during which one or more frame synchronization losses occurred or during which frame synchronization could not be achieved.

36-CRC SES

Severely Errored CRC Seconds — A count of seconds during which the total number of CRC errors and frame synchronization losses equalled 320 or more.

37-CRC ERR RT

CRC Error Rate — A count of CRC errors divided by the total number of ESF superframes analyzed.

31. MAINFRAME — SIGNAL CATEGORY

40-RX FREQ, Hz

Receive Frequency in Hz — The frequency of the clock recovered from the received data.

41-RX LEVEL dBdsx

Receive Level in dBdsx — The level of the received signal in dB relative to a standard 3-volt base-to-peak signal (DSX level).

42-RX LEVEL dBm

Receive Level in dBm — The power level of an all-ones signal (applicable only when all ones is detected).

43-RX LEVEL V p-p

Receive Level in Volts — The level of the received signal in peak-to-peak volts. The signal level is displayed as V or mV when it is higher or lower than 1 volt, respectively.

44-PULSE SHAPE

Pulse Shape — A PASS/FAIL result which shows whether the T1 pulse shape is within the boundary of the specified pulse mask.

45-PULSE WIDTH

Pulse Width — The pulse width of a T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.

46-RISE TIME

Pulse Rise Time — The time interval between the 10% and 90% points of the rising edge of the T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.

47-FALL TIME

Pulse Fall Time — The time interval between the 10% and 90% points of the falling edge of the T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.

48-UNDERSHOOT

Undershoot — The level difference from the minimum point to the 0% point of the T1 pulse. UNDERSHOOT is displayed as a percent of the normalized pulse where the normalized pulse height equals 100%.

49-OVERSHOOT

Overshoot — The level difference from the maximum point to the 100% point of the T1 pulse. OVERSHOOT is displayed as a percent of the normalized pulse where the normalized pulse height equals 100%.

50-SPX CURRENT

Simplex Current — The magnitude of the simplex current flowing between the transmit output tip and ring and the receive input tip and ring.

51-TIMING SLIP

Controlled Timing Slips — Timing slips are counted when the RECEIVER input has slipped ±193 bit time periods from the T1 REF input. Single bit slips are displayed graphically next to timing slips (see functional description).

53-SLP ANA SEC

Timing Slip Analysis Seconds — A count of test seconds during which Timing Slip Analysis has been performed.

32. MAINFRAME — TIME CATEGORY

60-SIG LOS SEC

Signal Loss Seconds — A count of test seconds during which the signal was not present or during which one or more signal losses occurred.

61-ALARMED SEC

Alarmed Second — A count of test seconds during which a Yellow, All Ones, Excess Zeros, or Ones Density alarm was detected.

62-TEST LENGTH

Length of a Timed Test — The currently set test length for a timed test, in HHH:MM format.

63-ELAPSED TIME

Elapsed Time — The number of hours, minutes, and seconds (1) since a proper frequency and level has been detected or (2) since the last major switch change.

64-TEST END IN

Time Remaining in Timed Test — Time remaining in a timed test, in HHH:MM:SS format.

65-CLOCK TIME

Clock Time of Day — The time of day in HH:MM:SS format.

66-DATE

Date — The date in DD MMM format.

33. MAINFRAME — JITTER & WANDER CATEGORY

70-WANDER +PK

Maximum Positive Peak Wander — The maximum positive peak wander deviation since the beginning of the test, defined in Unit Intervals (UIs).

71-WANDER -PK

Maximum Negative Peak Wander — The maximum negative peak wander deviation since the beginning of the test, defined in UIs.

72-P-P WANDER

Peak-to-Peak Wander — The total deviation of positive-to-negative peak wander since the beginning of the test, defined in UIs.

73-15m WANDER

Maximum Peak-to-Peak Wander Over 15 Minutes — The maximum peak-to-peak wander deviation over the last 15 minutes of the test. This result is unavailable for the first 15 minutes of the test and is updated once per minute thereafter.

74-24h WANDER

Maximum Peak-to-Peak Wander Over 24 Hours — The maximum peak-to-peak wander deviation over the last 24 hours of the test. This result is unavailable for the first 24 hours of the test and is updated once per hour thereafter.

75-TIE WANDER

Time Interval Error Wander — The variation in time delay of a given timing signal with respect to the T1 reference signal or external clock source over the test interval. Valid range is + 99999 UI.

80-WB/HB JIT

Wideband and Highband Jitter — A pass/fail measurement of wideband and highband jitter on a received T1 signal when compared to the CCITT O.171 jitter mask. (Pass/Fail criteria: wideband jitter greater than 5 UI; highband jitter greater than 0.1 UI.)

81-WB JITTER

Peak-to-Peak Wideband Jitter — The current amount of peak-to-peak wideband jitter, defined in UIs, updated once per second.

82-HB JITTER

Peak-to-Peak Highband Jitter — The current amount of peak-to-peak highband jitter, defined in UIs, updated once per second.

84-MAX WB JIT

Maximum Peak-to-Peak Wideband Jitter — The maximum amount of peak-to-peak wideband jitter since the last test restart, defined in UIs.

85-MAX HB JIT

Maximum Peak-to-Peak Highband Jitter — The maximum amount of peak-to-peak highband jitter since the last test restart, defined in UIs.

88-SA P/F

Spectral Analysis Content — A pass/fail comparison between the spectral content of each frequency band and the jitter mask selected in the AUX JIT MASK function.

89-SA FREQ

Relative Jitter in All 40 Frequency Bands — The relative amount of jitter present in all 40 frequency bands. Each frequency band and result are automatically scrolled in the display.

90-SA FREQ

Relative Jitter in Each Frequency Band — The relative amount of jitter present in each of the 40 frequency bands. Each frequency band is displayed manually by pressing the **RESULTS I** or **II Results** switch.

TDR170 DLC ANALYZER OPTION
SIGNAL ALARMS AND TEST RESULTS

SIGNAL ALARMS
TEST RESULTS
SUMMARY CATEGORY
DATALINK CATEGORY
CHANNEL CATEGORY
TIME CATEGORY

34. DLC ANALYZER OPTION — SIGNAL ALARMS

T1 Pulses — The green LED illuminates when valid T1 pulses are detected. The red history LED illuminates when T1 pulses are no longer detected after initial signal detection.

Frame Sync — The green LED illuminates when the T-BERD DLC Analyzer has achieved frame synchronization with the selected framing pattern (see **FRAME** switch). The red history LED illuminates when frame synchronization is lost, after initial frame synchronization.

Alarms — The current red LED illuminates when any of the following conditions are detected in the SLC datalink.

- Major alarms
- Minor alarms
- Power/miscellaneous alarms
- Shelf alarms
- Far-end loop event
- Switch to protection line event
- Automated maintenance test event

If the current LED is illuminated, check the SUMMARY category for the current alarms and messages. If the history LED is illuminated, check the DATALINK category for the previously received alarms and messages.

B8ZS — The current green status LED illuminates when B8ZS clear channel encoding is detected in the received signal.

35. DLC ANALYZER OPTION — TEST RESULTS

The categories are selected with the **RESULTS I** and **II Category** switches. Pressing the switch illuminates the category LED and displays the previously displayed category result. The category results are displayed by pressing the **RESULTS I** and **II Results** switches.

Most messages and results are preceded with either a "P" or "S" to indicate the input source, PRIMARY RECEIVE or SECONDARY RECEIVE.

The four categories and the available messages and results are listed as follows.

SUMMARY Category

Flashing Messages
P/S SIGNAL LOSS
P/S DATALINK SYNC LOSS
SW PROT FAILED
OPTION NOT INSTALLED

Maintenance Messages
P/S MAINT PROCEED
P/S MAINT HOOK/SEIZE
P/S MAINT TEST ALARM

Current Alarm Messages
P/S MAJOR SHELF x
P/S MAJOR NO SHELF
P/S ALARM SHELF x
P/S SHELF x ON PROT
P/S FE LOOP PROTECT
P/S FE LOOP SHELF x
P/S MINOR
P/S PWR/MISC

T1 Signal Errors
P/S VIOLATION
P/S FRM ERROR
P/S CRC ERROR

Results Messages
ALL RESULTS OK
ALL RESULTS UNAVAILABLE

DATALINK Category

Alarm Messages
P/S MAJOR SHELF x
P/S MAJOR NO SHELF
P/S ALARM SHELF x
P/S SHELF x ON PROT
P/S FE LOOP PROTECT
P/S FE LOOP SHELF x
P/S MINOR
P/S PWR/MISC

Maintenance Messages
P/S MAINT PROCEED
P/S MAINT HOOK/SEIZE
P/S MAINT TEST ALARM

Datalink Results
P/S SLC A SEC
P/S DL BITS
P/S ALM FIELD

CHANNEL Category

Channel Signaling
P/S TRAFFIC CHANNEL AB
P/S TRAFFIC CHANNEL ABCD
P/S TRAFFIC TIMESLOT AB

VF Results
P/S VF LEVEL
P/S VF FREQ
P/S DATA BITS
DTMF SEQ
P/S TS CH

TIME Category

TIME
DATE
P/S SIG L SEC

36. DLC ANALYZER OPTION — SUMMARY CATEGORY

Flashing Messages

P/S SIGNAL LOSS

Signal Loss — This message indicates the T1 signal has been lost after initial signal presence on the indicated receiver. The message flashes until the signal returns (T1 Pulses LED illuminated).

P/S DATALINK SYNC LOSS

Datalink Synchronization Loss — This message indicates that datalink synchronization has been lost after initial datalink synchronization. The message flashes until datalink synchronization is regained.

SW PROT FAILED

Switch to Protection Line Failed — This message indicates a switch to protect request cannot be completed. The message flashes once with each occurrence.

OPTION NOT INSTALLED

Option Not Installed — An option is not currently installed or available. The message flashes once with each attempt.

Alarm Messages

P/S MAJOR SHELF x

Major Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by a shelf or shelf group (x = A, B, C, or D).

P/S MAJOR NO SHELF

Major Alarm, No Shelf — This message indicates a system state that is characterized by a loss of service to the subscribers with no associated shelf alarm.

P/S ALARM SHELF x

Shelf Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by the indicated shelf (x = A, B, C, or D).

P/S SHELF x ON PROT

Shelf x on Protection Line — This message indicates that one of the shelves has switched to the protection line (x = A, B, C, or D).

P/S FE LOOP SHELF x

Far-End Loop on Shelf x — This message indicates that a request is being sent to the far end to loop one of the four shelves (x = A, B, C, or D).

P/S FE LOOP PROTECT

Far-End Loop on Protection Line — This message indicates that a request is being sent to the far end to loop the protection line.

P/S MINOR

Minor Alarm — This message indicates a system state that is characterized by a non-service affecting fault.

P/S PWR/MISC

Power/Miscellaneous Alarm — This message indicates a power loss, high temperature, smoke, high water, open door, or other defined condition exists.

Maintenance Test Messages

P/S MAINT HOOK/SEIZE

On-Hook/Seize Maintenance Message — This message appears when either the on-hook or seize message is received.

P/S MAINT PROCEED

Proceed Maintenance Message — The maintenance bypass procedure continues or has succeeded.

P/S MAINT TEST ALARM

Test Alarm Maintenance Message — The maintenance bypass procedure has failed.

T1 Signal Errors

P/S VIOLATION

Bipolar Violation Count — A count of BPVs detected since the start of the test (excluding intentional violations found within B8ZS encoding).

P/S CRC ERROR

CRC Errors — A count of CRC errors detected. CRC errors are counted only when ESF framing is present in the received T1 data.

P/S FRM ERROR

Frame Errors — A count of the frame errors detected since the start of the test. For D4 or D1D framing, frame errors are counted if either an F_t or an F_s frame bit is in error. For ESF framing, frame errors are counted on FPS bits. For SLC-M1 or SLC-M2 framing, frame errors are counted only if an error is found on an F_t bit.

37. DLC ANALYZER OPTION — DATALINK CATEGORY

Alarm Messages

P/S MAJOR SHELF x

Major Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by a shelf or shelf group (x = A, B, C, or D).

P/S MAJOR NO SHELF

Major Alarm, No Shelf — This message indicates a system state that is characterized by a loss of service to the subscribers with no associated shelf alarm.

P/S ALARM SHELF x

Shelf Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by the indicated shelf (x = A, B, C, or D).

P/S SHELF x ON PROT

Shelf x on Protection Line — This message indicates that one of the shelves has switched to the protection line (x = A, B, C, or D).

P/S FE LOOP SHELF x

Far-End Loop on Shelf x — This message indicates that a request is being sent to the far end to loop one of the four shelves (x = A, B, C, or D).

P/S FE LOOP PROTECT

Far-End Loop on Protection Line — This message indicates that a request is being sent to the far end to loop the protection line.

P/S MINOR

Minor Alarm — This message indicates a system state that is characterized by a non-service affecting fault.

P/S PWR/MISC

Power/Miscellaneous Alarm —This message indicates a power loss, high temperature, smoke, high water, open door, or other defined condition exists.

Maintenance Test Messages

P/S MAINT HOOK/SEIZE

On-Hook/Seize Maintenance Message — This message appears when either the on-hook or seize message is received.

P/S MAINT PROCEED

Proceed Maintenance Message — The maintenance bypass procedure continues or has succeeded.

P/S MAINT TEST ALARM

Test Alarm Maintenance Message —The maintenance bypass procedure has failed.

Datalink Status Results

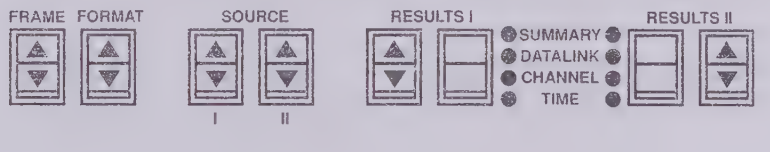
P/S SLC A SEC

SLC Alarmed Seconds — The number of test seconds during which datalink alarms, maintenance tests, or switch to protection line messages were detected.

P/S DL BITS

SLC Datalink Bits —This result displays the individual datalink bits. The display indicates the concentrator (CCCCCCCCCCC), maintenance (MMM), alarm (AA), and protection line switch (SSSS) fields. This result is only available when the T-BERD DLC Analyzer is frame synchronized in the SLC-M1 or SLC-M2 mode. The spoiler bits are shown without characters above them.

FRAME FORMAT	P DATALINK BITS	CCCCCCCCCCC 10101010101	MMM AA SSSS 010 011 11 0111 1



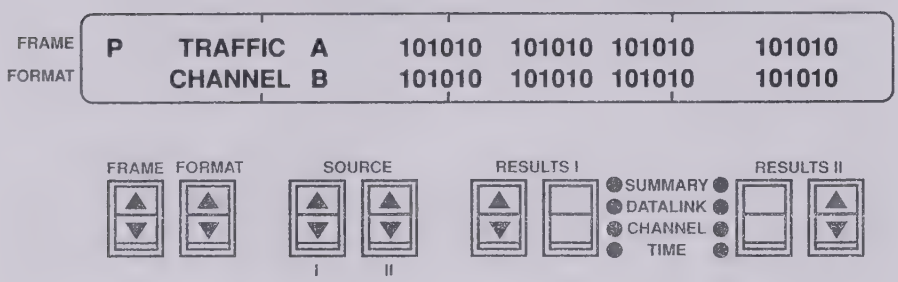
P/S ALM FIELD

Alarm Field Format — Identifies the received datalink alarm field format as either 13 bit or 16 bit.

38. DLC ANALYZER OPTION — CHANNEL CATEGORY

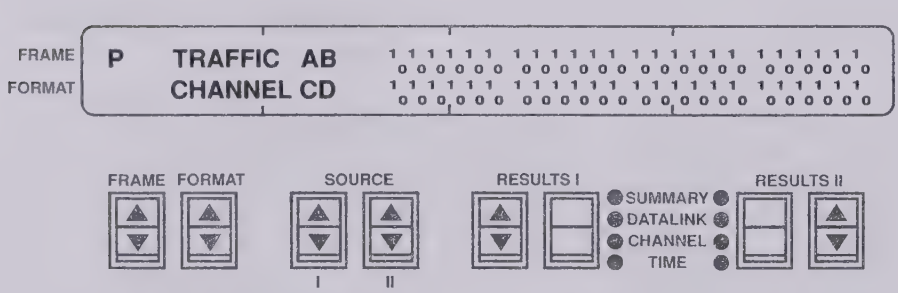
P/S TRAFFIC CHANNEL

AB Traffic Channel Signaling Bits — This result displays the A and B signaling bits in all 24 channels. This result is available in the SLC-M1, T1 D1D, T1 D4, and AUTO frame modes, but not SLC-M2 or T1 ESF.



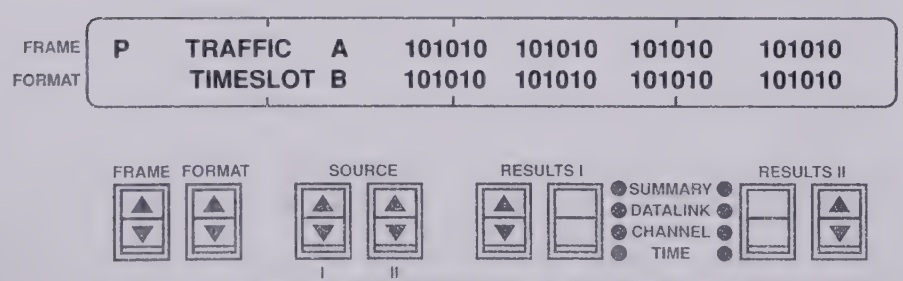
P/S TRAFFIC CHANNEL

ABCD Traffic Channel Signaling Bits — This result displays the A, B, C, and D signaling bits in all 24 channels. This result is only available in the T1 ESF frame mode.



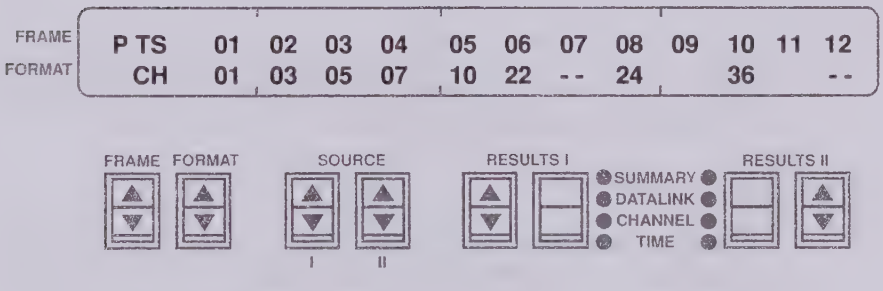
P/S TRAFFIC TIMESLOT

Traffic Signaling Bits for SLC-M2 Timeslots — This result displays the A and B signaling bits in all timeslots from a single receiver input. This is only available in the SLC-M2 frame mode.



P/S TS CH

SLC-M2 Timeslot Channel Assignments — This result displays the timeslot channel assignments of a Mode 2 SLC-96 circuit. An unassigned timeslot is indicated by two dashes (——). An unknown timeslot assignment is left blank. This result is only available in the SLC-M2 frame mode and when the signal is received from the LDS. The result can be updated by sending the MAPPINGS command.



P/S VF LEVEL

Received VF Signal Level in dBm — A measurement of signal power in the currently selected DS0 channel.

P/S VF FREQ

Received VF Frequency — The VF frequency, measured in Hertz, of the received VF data in the currently selected DS0 channel.

P/S DATA BITS

DS0 Channel Data Bits — Displays the binary values of the selected DS0 channel.

DTMF SEQ

Dual-Tone Multi-Frequency Sequence —Displays 11 digits of the received telephone number in the currently selected DS0 channel.

39. DLC ANALYZER OPTION — TIME CATEGORY

TIME

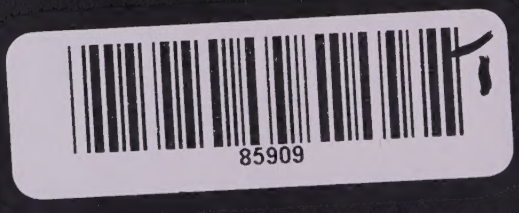
Time of Day — The current time of day in HH:MM:SS format. This is set with the SET TIME auxiliary function.

DATE

Date — The current date in MMM DD format. This is set with the SET DATE auxiliary function.

P/S SIG L SEC

Signal Loss Seconds — A count of test seconds during which the signal was not present or during which one or more signal losses occurred after the initial signal detection.



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